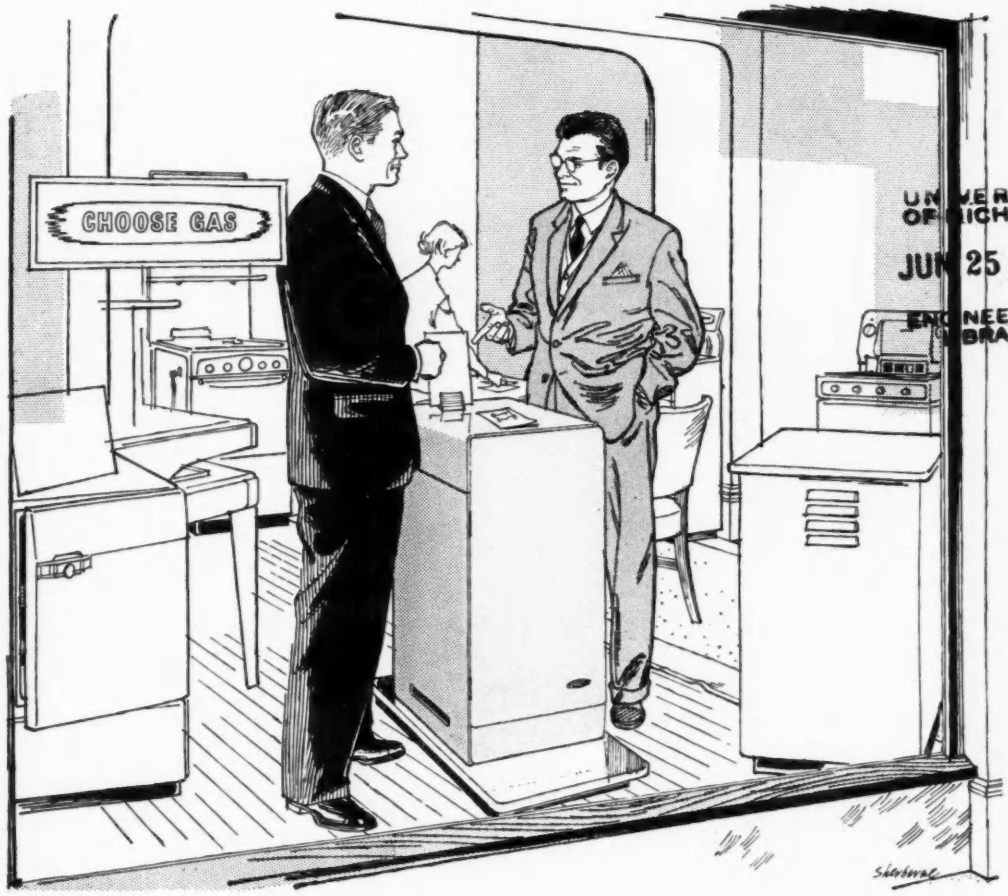
Gas Journal

VOL. 294. 110th YEAR. LONDON, JUNE 11, 1958. No 4952. PRICE 1/6



UNIVERSITY OF MICHIGAN
JUN 25 1958
ENGINEERING LIBRARY

ke selling the 'Diplomat' Boiler—
in fact I've bought one myself!"

He has every opportunity of comparing prices, and he knows the price of a 'Diplomat' boiler to be sound. When ordering a 'Diplomat' he is sure, also, of a really effective after-sales service.

He knows the 'Diplomat' Gas-Fired Boiler adapts itself to the specific routine and requirements of any household. Fitted with a clock having a 4 tappet dial, it turns itself on and off automatically at pre-selected times. Running costs are, therefore, kept to a minimum. There is no more efficient means of providing a medium sized house with ample hot water, a warm airing cupboard and one or two radiators.

He likes his job, but he likes it all the better when he sells at a fair price something which looks good and he knows to be good—something like a 'Diplomat' Gas-Fired Boiler that he is glad to install in his own house.

Just right for price.

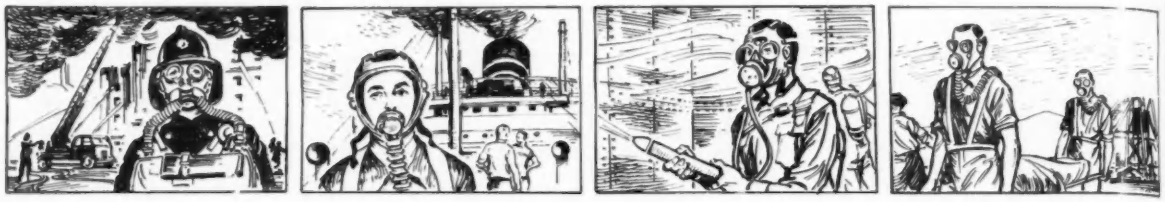
'DIPLOMAT' *Gas-Fired Boilers*

models of self-control

POTTERTON DIVISION, Thomas De La Rue & Co. Ltd.,
20/30 Buckhold Road, London S.W.18.

DL83

Whatever the hazard . . .



. . it's safer with

SIEBE, GORMAN
ESTABLISHED 1819

THE PURETHA MARK IV GAS RESPIRATOR

This respirator is simple to adjust and is comfortable enough to be worn for long periods. In conjunction with a full range of canisters, the PURETHA is intended for use in low concentrations of gas. The facepiece is of moulded rubber, and the self-clearing eye pieces are of splinterless glass which remains gas-tight even if cracked. Alternative harness arrangements permit canister to be worn on chest, at side or on the back. The PURETHA has been tested and approved by the Ministry of Labour and National Service.

SIEBE, GORMAN are long-established suppliers of all types of safety equipment to the Admiralty, the Public Services and Industry.

Siebe, Gorman & Co., Ltd., Neptune Works, Davis Road, Chessington, Surrey
TELEGRAMS: SIEBE, CHESSINGTON - TELEPHONE: ELMBRIDGE 5900
Manchester Office: 274 Deansgate - Telephone: Deansgate 6000

THE "CL" VALVE FOR GAS

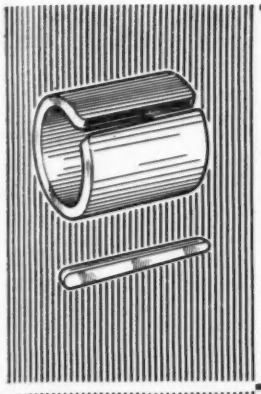
- CORROSION RESISTING STEEL DOOR.
- SPECIAL RESILIENT NON-METALLIC COMPOSITION SEATS SELF-LUBRICATED.
- SIMPLE AND ROBUST IN CONSTRUCTION.
- POSITIVE IN OPERATION.
- NO WEDGES OR SPRINGS.
- CANNOT JAM — OPEN OR CLOSED.
- SPINDLE CAN BE RE-PACKED IN THE OPEN OR CLOSED POSITION.
- STANDARD TEST PRESSURE 100 LBS. PER SQ. IN. AIR.
- INTERNAL OR EXTERNAL SCREW WITH OR WITHOUT INDICATOR.

SIZES 3" TO 24"
HORIZONTAL AND VERTICAL

The BRYAN DONKIN CO. LTD
CHESTERFIELD (TEL. 3153) LONDON, MANCHESTER

MEMBER OF THE SOCIETY OF BRITISH GAS INDUSTRIES

BUSHES



WALTER PATENT SPLIT BUSHES

in

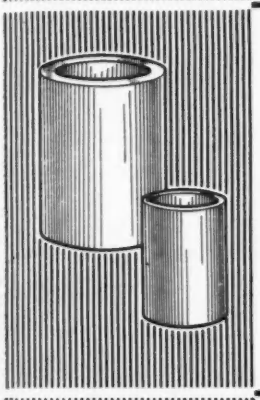
CASE-HARDENED STEEL

NON-CORRODIBLE HARDENED STAINLESS STEEL

NON-CORRODIBLE BRONZES

Manufactured in other materials to customer's specification

Supplied with taper keys in size range ⅜" to 12" internal diameter



PLAIN BUSHES

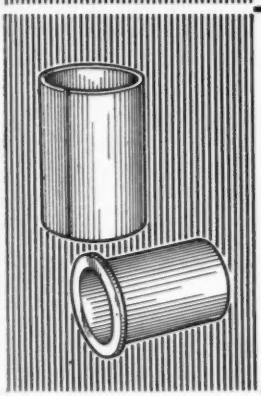
in

HARDENED & GROUND STEELS

HARDENED STEELS (Burnished finish)

NON-CORRODIBLE HARDENED STAINLESS STEELS (Ground or Burnished Finish)

BRONZES - Thin or thick walled



WRAPPED BUSHES

in

STEEL

BRONZES - Thin or thick walled

FLANGED BUSHES

in

STEEL

BRONZE

- Manufacture of Bushes in other materials to customer's specification
- Large or small quantities

SPE COMPANY LTD.

20 - 26 LAMB'S CONDUIT STREET LONDON . W.C.1.

Telephone: HOLborn 1402 Telegrams: SPECOMPANY, WESTCENT, LONDON

Gas Journal

VOL. 294 NO. 4952 11 JUNE, 1958

110TH YEAR

MANAGING DIRECTOR: Clifford A. King

EDITOR: Geoffrey W. Battison

ASSISTANT EDITOR: Colin J. Godbold

TECHNICAL EDITOR: Charles J. P. de Winton, T.D., M.A., M.Inst. Gas E., M. Inst. F.

Published by Walter King Limited,

11, Bolt Court, Fleet St., London, E.C.4

Telephone: FLEet Street 2236-7 Telegrams: Gasking, Fleet.

CONTENTS

EDITORIAL COMMENT

The Industry and the Public .. 579
The Widening Influence of Work Study .. 580
Their Beauty Saved Them .. 581

NEWS OF CURRENT EVENTS

Correspondence : Further Remarks on Removal of Sulphur from Town Gas—Thermion, F. G. Pyper .. 581
Personal .. 582
Obituary .. 582
Diary .. 582
W.M.G.B. Long Service Awards .. 582
W.M.G.B. First Aid Finals .. 582
Paisley Inspected .. 582
Joint Meter Readings .. 582
Belfast Coal Rumpus .. 583
Thomas De La Rue & Co., Ltd. .. 583
New Industrial Sales Drive for Scotland .. 583
Foxboro-Yoxall Open New Factory .. 583
Clean Air Society Visits Dumbarton .. 584
Public Lighting Conference .. 584
Municipal Treasurers' Conference .. 584
Purchasing Officers' Booklet .. 584
Australian Gas Light Company .. 584
Danish Gas Engineers in England .. 584
Company Meetings .. 584
Gas at the International Exhibition .. 585
B.S. for L.P. Gas Lamps .. 586
Science Museum Gas Publication .. 596
Notes on Water Pollution .. 596
New Tool for Pipework .. 596
Training Technical Authors .. 596

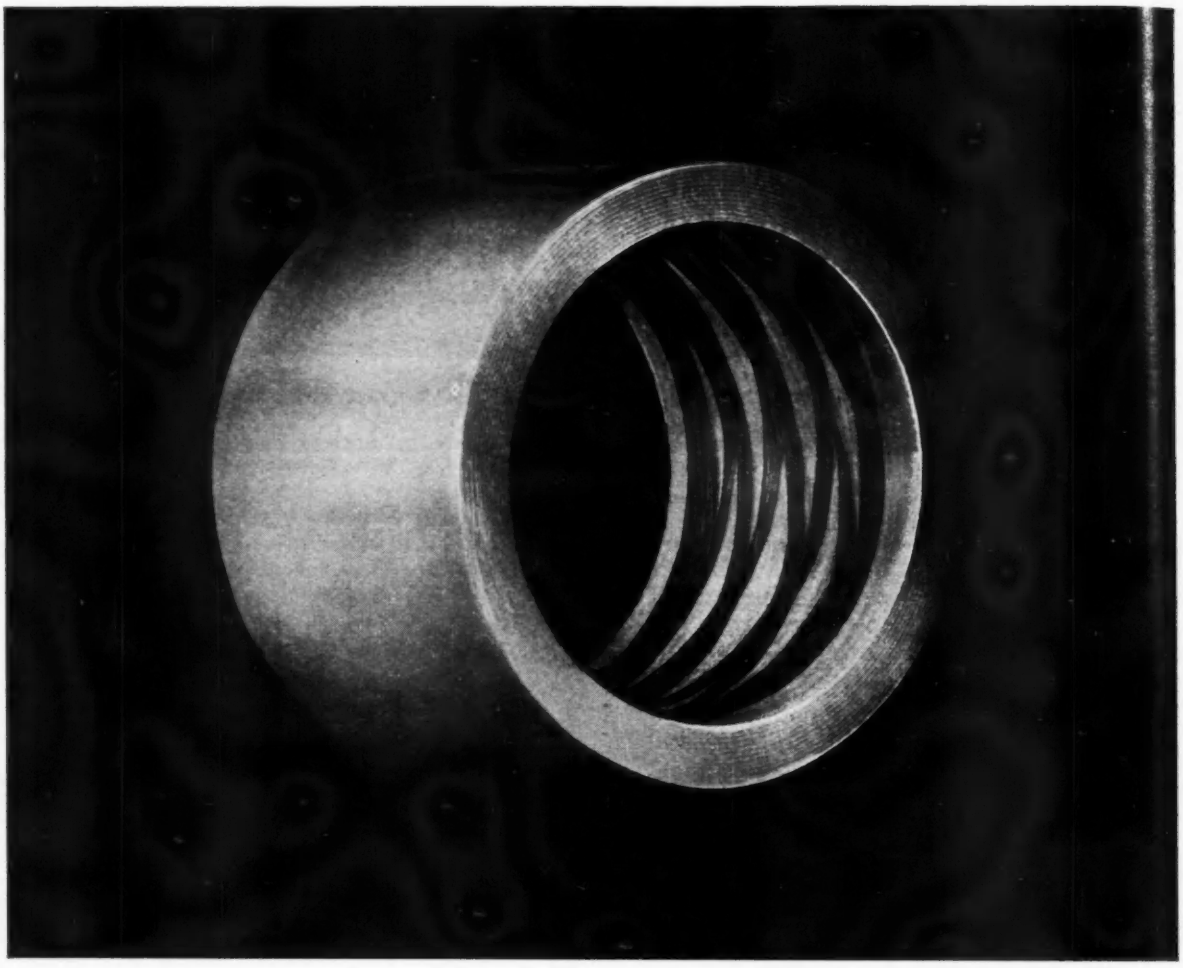
FEATURE ARTICLES

His Motto was 'More Light.' By M. Schofield .. 586
New Glover-West Plant at Orange .. 589

TECHNICAL RECORD

Gas on the Continent .. 591
Industrial Progress and the Plant Engineer. By L. Landon Goodman .. 593
Trends in Gas Compressor Design. By J. B. Taylor .. 597

PUBLISHERS' NOTICE, SEE PAGE 607



There is more in gas metering than meets the eye

This is the journal of a self-lubricating bearing used in Parkinson Cowan industrial meters.

The phosphor bronze journals run on hard-wearing stainless steel pivots in all bearings. The spiral grooves inside the journals are packed with bonded graphite which provides continuous lubrication of the bearings throughout the long life of the meter. No other bearing lubrication is required.

It is the thorough design, meticulous manufacture and careful assembly of each component that has made Parkinson Cowan meters so famous for long life with consistent accuracy.

PARKINSON COWAN GAS METERS

Terminal House, 52 Grosvenor Gardens, London, S.W.1. SLOane 0111

RB P

Gas Journal

VOLUME 294. No. 4952. JUNE 11, 1958. 110th YEAR

The Industry and the Public

IT is now universally recognised that if any enterprise is to be successful, it must have an efficient public relations department. This is as true of the gas industry generally as it is of the area boards, for the public as a whole as it is for those directly interested in the manufacture and utilisation of gas. It is generally more difficult to convince those outside the industry of the developments taking place when our competitors in the electricity and oil industries have such spectacular things to offer in the form of vast Atomic Energy power stations, all the talk about Zeta and mammoth refineries which manufacture a (nationally) modern product on a vast scale with valuable chemicals as by-products. The gas industry has had its difficulties in the past—indeed, 'gas company bating' seems to have been a sport enjoyed by a number of people at one time. Even today some members of the general public are of the erroneous opinion that because the prices for gas have risen, and coke can no longer be obtained at give-away prices, the industry must therefore be stagnating and about to suffer extinction.

To all those engaged in the industry such a notion is clearly fantastic, but to the general public, conditioned to rival advertising propaganda, it might not seem so fantastic. It was, therefore, with the greatest possible interest that we read the supplement published by *The Times* last week on 'The Future of Gas.' Here was a magnificent piece of propaganda for the industry distributed gratis. Although the circulation of *The Times* may be small compared with the popular dailies, it is read by the 'top people' of both 'today and tomorrow,' and it may well be that such people still think of the gas industry as represented by that stinking little hole at the bottom of the town and the wheezing gas lamp of very varying illumination. This supplement should dispel any memories of this kind since from the introduction the emphasis in all the articles is on the developments in the last nine years and the tremendous energy with which the problems of the day are being tackled. In fact it is most noticeable that throughout the supplement the carbonisation of coal is barely mentioned. Even when it is, it is generally referred to as an orthodox method of gas making on which the industry was once dependent, but which is now fast receding.

To the ordinary gas consumer, the real change in the industry has been the improvement in gas supply by the laying of a more adequate mains system and the raising of the gas pressure by boosting and compression, but we feel that this supplement will bring before him in a much more vivid form than hitherto what is really behind these very real improvements. Any striking improvement in technique in any industry is reported from time to time as news but it is doubtful to what extent the reader really grasps the significance of such advances. By the publication of specialised supplements of this kind, written by experts, in this case principally by the area board chairmen, in a language all can understand, the ordinary, intelligent reader can be made fully aware of what lies behind such items of news. It will very probably come as something of a surprise to many to learn the number of specialists and the amount of specialised knowledge it is necessary to employ in the industry today. The plans for the use of oil, the scaling up of plant for its gasification by the Chemical Engineer (a comparative new-comer to the industry), the use of new techniques by the civil engineer and the new conception of gas manufacturing plant from the plant engineer's standpoint with all his organisation of repairs and planned maintenance, give a clear idea of the way the industry is using all the newest methods available.

But all the most favourable propaganda which the influence of the prestige of *The Times* can give, is worth little if the price of gas to the consumer cannot be reduced. The supplement contains a contribution from the two research stations of the Gas Council: That from the London station deals with the gasification of low grade coal and oil, and that from the Midlands with the pressure processes by which a higher quality gas is likely to be made at a lower cost. These projects should come to fruition in the foreseeable future, when perhaps the gasworks will be at the pit-head and the

national grid an accomplished fact. If such impressions can be left with the lay public, it would be fair to suppose that the gas industry will no longer need to fight a kind of delaying action with its domestic consumers while it develops other commercial and industrial markets.

The picture which emerges should make it quite clear that if the problems that faced the industry after the war had not been so resolutely tackled, the costs of gas production would have priced it completely out of the fuel market. The work going on at the research stations, together with the improvement in design of gas appliances, is the natural continuation of our evolutionary process. Since it is reasonable to suppose that oil gasified in the gasworks and distributed by a mains system is better than the consumption of oil by domestic and other users, and that low grade coal is better consumed as a refined fuel gas than in the domestic grate, there seems no reason to suppose that the gas industry need have any real fear of its future competitors. Here, again, however, the secret of success lies in good propaganda.

The Widening Influence of Work Study

PRACTISING what one preaches is generally agreed to be an excellent thing, a rule which is followed by people successful in many spheres. Among the followers may be numbered Messrs. H. B. Bassett and W. J. G. Bryce whose paper on work study was one of the highspots of last year's Institution Meeting. Listening to them giving a rehash—perhaps too unkind a word for something containing much new material—of their paper at the Wales and Monmouthshire Section meeting at Llandrindod Wells last Friday it struck us that what appeared to be application of work study to the presentation of a technical paper can produce a result no less rewarding that the application of such techniques to other undertakings. Indeed, this proved to be an object lesson in holding the audience's attention without indulging in light relief and while sticking firmly to the point. It would appear that Messrs. Bassett and Bryce may popularise work study in the gas industry in much the same way as Dobson and Young have popularised classical music—and with methods which are not entirely dissimilar.

Save for a comparatively brief introduction, the authors took their original paper (Communication 509) as read and sought to explain some of the results which had been obtained since its preparation. Mr. Bryce dealt with the benefits obtained by work study in the retort house and Mr. Bassett with those obtained on the service side. One sensed that their talk had been loaded in favour of the latter field of application in view of the dwindling scope for gas manufacture in the Wales area and the growing emphasis on sales and service. Nevertheless, both sets of results impressed those present and we do not think it was imagination on our part which made us sense at least a partial conversion among some of the more sceptical members. Readers will have an opportunity of studying these results in the 'JOURNAL' in a week or so, but at the meeting their basic merit was enhanced by the authors' ability to explain them engagingly and to answer questions quickly, authoritatively, and without recourse to the horrible jargon which so often characterises the literature of work study.

However, the authors did not have everything their own way. Just when the meeting was flushed with the warmth of friendly persuasion, there came a cold douche from none other than Dr. A. B. Badger, the Industrial Relations Officer of the Gas Council. While in no way opposed to work study, he nevertheless felt it necessary to point out that putting this technique into practice was not as easy as it might appear to be. You can have a job in which relations between management and men are excellent, he said, but when you apply work study to one section of the employees and deny it to the rest, you have a potentially dangerous situation. By suggesting to a man that in the past he has not done his job properly, that you are going to apply scientific principles to his efforts, and that you are asking him to increase not production but productivity—a very different thing—you ran the risk of arousing fear, uncertainty and resentment. Successsful work study was 90% human relations; the workman should be able to calculate, without external assistance, what he was going to earn, otherwise he would feel he had been diddled. And Dr. Badger pointed out that in the United States the workers believed that when a certain point of production was reached, there was an increasing return for the management and a decreasing return for the worker; for this and other reasons America, the home of the incentive bonus, was abandoning such methods because they led to bad industrial relations.

Dr. Badger's remarks, which stressed the importance of making employees understand what was going on and giving them the fullest reassurance concerning the safety of their jobs, will also be reported in full in a future issue. We have quoted some of his comments here because we think they are significant coming as they do from a man of formidable experience in the field of industrial relations.

There seems to be little doubt that work study will soon be as firmly entrenched in the gas industry as it is in other industries. Properly applied, it has been shown to bring a rich reward. Already we know of five area boards which are to some extent engaged in work study, and the inclusion of a further paper on the subject (by Mr. David Beavis) at this year's Institution meeting was a mark of further acceptance. In the circumstances the presence of prophets like Messrs. Bassett and Bryce is an important factor. If Mr. W. R. Branson, the high priest of work study in the West Midlands Board, will allow these gentlemen to spread the gospel freely in the gas industry, it will be most helpful to all concerned. We hope that the visit to Wales will be the first of a series; presumably it is up to other district sections and associations to make the request. It is most important that the practitioners of work study—and here we are quoting Dr. Badger again—should have the feel of an industry. That Messrs. Bassett and Bryce have that quality is beyond doubt.

Their Beauty Saved Them

THE days of gaslight are over. Each year a little of what is left of this commercial load is wrested from us by the enemy. But we do not begrudge this loss: Whatever our views about the superiority of gas as a source of heat, and however brilliantly gas may have lit the scene a century ago, no one suggests that gas can hold a candle to electricity for providing light today. All the same, we rue the passing of the old familiar landmarks, the giving place to gaunt excrescences of concrete by the old attractive wrought iron lanterns, on their graceful standards, even though their soft and friendly light is no longer adequate in the hurried age we live in.

We are not, of course, alone in this. A number of bitter private battles have been fought by members of the public who have felt as we do when these refulgent power-age totem poles have been erected outside their homes or in their favourite haunts. But it came as pleasant surprise, indeed, to find that so progressive a body as the London County Council shares our feelings. And that when the decision was made to scrap gaslighting over Putney Bridge, the Council further decided to sacrifice a measure of the efficiency of the new electric lights by housing them in the old gas lanterns in order to preserve the bridge's character.

The lanterns, which were installed in 1886 when the present bridge was opened, are of sheet copper and of first class workmanship. It was this fact, coupled with their beauty of design, that led to the decision to convert rather than replace them. When they were first put into service they were fitted with a five- or six-branch fish tail or flat flame burner. The inverted incandescent mantle which replaced the burner in 1902, remained in use up to the time of conversion. Of the 34 lanterns the six centre ones were fitted with ten No. 2 mantles each, the remainder being fitted with six No. 2 mantles.

As the total lumen output of six No. 2 mantles is of the order of 3,100 lumens and that of a 250 watt colour-corrected mercury lamp, as now fitted, is 10,100 lumens, the light output is now three times greater than before. But the spread of light over the carriageway is not as even as it would be with a modern electric light fitting. The hourly consumption of gas for six No. 2 mantles was 14.5 cu.ft.; the one 250 watt lamp consumes .265 units.

CORRESPONDENCE

Further Remarks on Removal of Sulphur from Town Gas

DEAR SIR,

The conclusions to be drawn from the I.G.E. discussion on sulphur removal appear to be:—

1. The need for sulphur removal is now generally appreciated.

2. Oil gas needs to be oil-washed, but the benzole made may be liable to Customs duty.

3. The cost of sulphur removal is the chief problem.

4. A relaxation in the absurdly stringent legal standard of hydrogen sulphide removal would help to pay for organic sulphur removal, and might provide the secondary purifiers required.

5. The discussion showed that the industry is fit to be entrusted with the responsibility for purifying its product in the way best suited to the consumers' needs, as competition provides a greater spur than legislative safeguards can.

The two major obstacles, then, are legal ones. May I suggest that your purchase tax petition has set up a precedent which could be followed in this case? As a basis for discussion, I submit the following proposals:

1. That all benzole extracted from gas by an area gas board shall be deemed by the Customs and Excise to be home-produced,

2. That the amount of hydrogen sulphide and total sulphur in gas supplied shall be tested by the Ministry's gas examiners, but the results shall be reported for information only. An area board shall not be liable to conviction for supplying gas containing sulphuretted hydrogen.

The second proposal would require no legislation, as the Gas Act merely empowered the Minister to prescribe standards of gas quality. The machinery for gas testing provides an excellent basis by which impartial persons may assist the boards to ensure that each works maintains a required standard of purity.

With regard to the check for hydrogen sulphide, I suggest the use of two papers in the present apparatus, only one of which would be impregnated with lead acetate, the test being the time of exposure taken for a perceptible difference to appear, up to a maximum of three minutes.

For total sulphur, absorption of combustion products in hydrogen peroxide would probably be best, by a method resembling the sulphur in benzole test, rather than the North Thames standard method, which would be unduly elaborate for this purpose. The N.T.G.B., from the wealth of its experience, should be able to suggest an empirical correction for the nitric acid formed.

Yours faithfully,

'THERMION.'

May 26, 1958.

DEAR SIR,

It appears from the summary of the discussion on the three sulphur papers in your issue of May 21 that I was not successful in making clear my comments on the papers. Very briefly, the main points I had hoped to make were:—

1. The amount of plant to be installed to obtain the high standard desirable throughout the whole country is very great and, in the East Midlands, we are endeavouring to deal with those localities where the need is greatest.

2. The use of East Midlands coal in the Nottingham and Derby districts does lead to the distribution of gas with a sulphur content of 30 grains or more per 100 cu.ft. There is also one coke oven plant in that area which supplies gas with a similar sulphur content. We have been promised the co-operation of the coke oven operators in improving this and we are proposing to install a catalytic sulphur removal plant or plants in that part of the area. The gas made in continuous vertical retorts and supplied now at 480 B.t.u. per cu.ft., to be increased later to 500, rules out the possibility of using the benzole extraction method.

3. In the Sheffield and Rotherham Division we already have accelerated oil washing plant at Rotherham and are installing similar plants in two of the Sheffield works. When these are complete, we have every hope of reaching an overall figure of something between 10 and 15 grains per 100 cu.ft. in that part of the area. In this connection the economics of benzole recovery are a little different from those put forward in the paper. The cost of replacement gas is very difficult to assess, but I think the 13d. quoted in the paper would be our top figure rather than the average.

Yours faithfully,

F. G. PYPER,
Chief Engineer.

East Midlands Gas Board,
Leicester.

June 2, 1958.

Personal

MR. R. F. BELL, Manager of Irvine District of the Scottish Gas Board, has been appointed Manager of the combined districts of Irvine, Ardrossan, and Saltcoats. This follows the transference of MR. I. SIMPSON, of Ardrossan, to Girvan, and the departure of MR. A. SIMPSON, of Saltcoats, to a new appointment under the Wales Gas Board as Engineer and Manager at Pembroke Dock. Mr. Bell went to Irvine as Manager in 1953, having formerly been Assistant Manager in Falkirk. His district formerly included eight gasworks, five of which have been closed in recent years as part of the process of centralisation of manufacture. MR. GEORGE LAING, Assistant Manager in Johnstone, has been appointed Works Superintendent at Ardrossan, and MR. KEITH MARROWS, a Technical Assistant in Kilmarnock, has been given a similar appointment at Saltcoats.

MAJOR DESMOND ABEL SMITH has retired as Chairman of The Bryan-Donkin Co., Ltd. He has been replaced by MR. ALEX ABEL SMITH, while MR. R. T. REDFERN has been appointed Vice-Chairman. VICE-ADMIRAL SIR CONOLLY ABEL SMITH, K.C.V.O., C.B., has been appointed to the Board. Mr. R. HUTCHINSON, of the Leicester & Northants Division, East Midlands Gas Board, has accepted the position of Technical Sales Manager operating from Chesterfield, while MR. B. I. STONE, London Manager of the Company, will continue to operate from the London office.

MR. P. A. HEARNE has been appointed Sales Manager of British Oxygen Aero Equipment Ltd. He was formerly a member of the project branch of B.O.A.C. and more recently was a helicopter project engineer with B.E.A., being responsible for development work on civil helicopters. He succeeds MR. DAVID INCE who is taking up an appointment as Divisional Manager of the guided weapons division of Elliot Brothers (London), Ltd.

Diary

June 12.—MIDLAND JUNIORS: Ladies' Day, including visits to the Stroud works of George Waller & Son, Ltd., and the Severn Wild Fowl Trust at Slimbridge.

June 20.—SCOTTISH WESTERN JUNIORS: Greenock Golf Course. Annual Golf Outing.

June 21.—EAST OF SCOTLAND JUNIORS: Perth. Annual Outing.

June 24-26.—INSTITUTION OF CHEMICAL ENGINEERS: Olympia, London, W.14. Symposium on the organisation of chemical engineering projects.

June 25.—WALES AND MONMOUTHSHIRE JUNIORS (NORTH WALES SECTION): Ladies' Day.

June 25.—I.G.E. (SOUTH WESTERN SECTION): Gloucester. Summer Meeting and Ladies' Day.

SIR GEORGE EVETTS, O.B.E., has been on the Roll of Corporate Members of the Institution of Civil Engineers for 50 years. The Council of that Institution has sent him a letter of congratulation. Sir George was elected an Honorary Member of the Institution of Gas Engineers in 1953.

MR. B. L. SCOTT has been appointed Manager of the Newcastle-upon-Tyne branch office of George Ellison, Ltd., in succession to MR. J. GIBBINS, who has retired after 46 years' service with the company.

MR. A. S. HUMPHRYS, Manager of the Australian office of Humphreys and Glasgow, Ltd., is in England on a month's visit to the firm's headquarters in London.

Obituary

MR. P. H. SUGG, who was for 33 years Chairman of William Sugg & Co., Ltd., died on May 21, aged 74. He joined the Company in 1902 and became Managing Director in 1920 and Chairman in 1921. Mr. Sugg resigned from the Chairmanship in 1954 and retired in 1956.

MR. JOHN K. MCCANDLESS, of Coleraine, has died at the age of 70. He was Secretary and a Director of Portrush Gas Company for many years.

MR. GEORGE ALFRED SYDNEY HARVEY, President of G. A. Harvey & Co. (London), Ltd., has died aged 74.

MR. JACK OLDING, President and Founder of Jack Olding & Co., Ltd., died last week.

W.M.G.B. MAKE SIX AWARDS FOR 40 YEARS' SERVICE

SIX employees in the Walsall and District Division of the West Midlands Gas Board were recently entertained to lunch with their wives and presented with 40 years' service awards.

The lunch followed a meeting of members of the Board at the George Hotel, Lichfield and the presentations were made by the Chairman, Mr. G. le B. Diamond. Each of the long service employees received a certificate and a gift of his own choice.

They were:— Mr. W. C. Waite, Divisional Industrial Gas Officer, No. 3 Division; Mr. H. S. Makin, Works Manager, West Bromwich; Mr. E. Dolan, foreman mechanic, West Bromwich; Mr. R. Bishop, meter reader/collector, Walsall District; Mr. H. E. Wilkins, gasfitter, West Bromwich; and Mr. S. J. Halford, chargehand fitter, Smethwick, who has now retired.

Mr. Diamond congratulated the Divisional General Manager, Mr. F. Harvey, on the work of the Division and welcomed as a guest Mr. F. H. Cureton, the first Secretary of the Board, who now lives in retirement in Sussex.

W.M.G.B. First Aid Finals

Mutual congratulations followed a double success by Birmingham teams in the finals of the W.M.G.B. Area First Aid Competition. They were exchanged by Miss K. F. Green and Mr. W. G. Hodnette. Miss Green led the Birmingham Divisional team—one of three ladies' teams which entered for the first time in the competition. Mr. Hodnette captained the Saltley team which had the top score among the men's teams.

Six of the seven men's teams competing had reached the Area Final by winning a Divisional eliminating contest. Saltley, previously winners in the Birmingham Division, scored a total of 207, against 203 obtained by the runners-up, Redditch, representing Worcestershire and Herefordshire Division.

The finals were held at the fine new Police Station at Coventry. At the conclusion trophies were presented by Mr. G. le B. Diamond, Chairman of the Board. The teams were faced with a number of 'incidents' including a realistically staged attempted suicide.

The two successful teams will represent the West Midlands Area in the Gas Industry national finals in London on October 10.

Paisley Inspected

ADDITIONS to the plant at Paisley gasworks were shown to members of the Scottish Western Junior Gas Association when they visited the installation recently. The guests were welcomed by Mr. George Wood, the Station Engineer. Among the company at a function which followed the visit was Mr. John Fraser, manager of the Paisley showroom, who is President-Elect of the Glasgow and Western Gas Salesmen's Circle.

Recently acquired plant at the works includes a diesel-driven alternator set, with a power output of 125 k.v.a., H.T. and L.T. electricity switch rooms, a new purifier building with overhead C.I. boxes which can purify 3.5 mill. cu.ft. per day, a new detarrer with a capacity of 6 mill. cu.ft. per day, a gas compressor with an output of 54,000 cu.ft. per hour at high pressure, and a coke-screening plant with a capacity of 25 tons per hour.

During 1957-58 the Paisley works made a total of over 1,354 mill. cu.ft. of gas and bought over 247 mill. cu.ft.

Joint Meter Readings

AT a recent meeting of the South Western Gas Consultative Council at Taunton, the Council agreed with its General Purposes Committee that, prima facie, joint meter reading and billing is desirable, and decided to recommend to the Government Committee that a trial of joint working should be undertaken in a few districts of differing types. The General Purposes Committee said that joint readings would considerably reduce the number of abortive calls by readers and collectors and save manpower.

BELFAST COAL RUMPUS

ALDERMAN ROBIN KINAHAN last week told a meeting of Belfast City Council that he intends to move a resolution at the next meeting of the Gas Committee that coal tenders received for the Gas Department's requirements in the current year should be sent to the Restrictive Practices Office of the Ministry of Commerce.

Mr. Kinahan, who alleged that a ring was operating, said that perhaps if the Ministry office investigated that matter tenders received next year would not all show the same price and have exactly the total requirements divided among them. A coal merchant had told him that he was making a fool of himself by his statements on the matter; but he thought he knew a ring when he saw one.

No Information on Act

There was an Act under which all rings and combines had to be registered with the Ministry, but he had been told in Parliament that there was no information about this particular one. He claimed that six firms were getting together and splitting up between them the Department's requirements. He believed that if they could break the ring perhaps one of the firms in it would quote the Corporation a more favourable price.

Ald. Thomas Henderson said he was sure the Council would give 100% support in having the matter brought to a head, and Coun. Irene McAlery said she could not understand why, despite repeated efforts made at Stormont, they could not get a clear picture of what was the actual coal situation. It might be worth while for the Gas Committee to examine the costs of chartering a steamer for its supplies.

Ald. George Kelso, Chairman of the Gas Committee, said there might be a ring: but if there was, not a great profit was being made. The profit worked out at about 6d. per ton—out of £6 12s.

Thomas De La Rue & Co.

THE Directors of Thomas De La Rue & Co,. Ltd., have decided that the former practice of having the different branches of the Company's activities controlled by separate subsidiary Companies had material advantages. The Finance Act, 1953, has removed the particular disadvantage which caused the Company to depart from these arrangements some years ago. It is proposed to revert to the former practice.

Industrial Editors' Awards

In our item on the Annual Convention of the British Association of Industrial Editors (last week's 'JOURNAL,' p. 534) we stated that Mr. F. E. Wiles, Editor of *Southern Service*, received an Award of Excellence. In fact it was Mr. J. Cawood, Editor of *Talking Shop* who, with Mr. R. V. Townsend, Editor of *Link-Up*, gained this distinction.

NEW INDUSTRIAL SALES DRIVE PLANNED FOR SCOTLAND

PLANS for a campaign to double the sales of gas to factories in the West of Scotland were announced at a meeting in Glasgow last week of the Scottish Gas Consultative Council. It was pointed out that at present only about 23 or 24% of the total output of gas was sold to factories at a cost of £1,500,000.

Describing the scheme the Chairman, Sir Robert Nimmo, said that a new division had been set up to strengthen industrial sales, and when it was in operation they would endeavour to meet the circumstances of each industrial consumer in the West of Scotland.

Explaining the object of the new division, Mr. H. R. Hart, Board Member and Glasgow and Western D.G.M., said: **'We have not been supplying anything like the quantity of gas to industry one might expect from a Board of this size. One of the reasons is that during the war years there was a shortage. It no longer applies.'**

A number of major contracts had been negotiated with heavy industries in the West of Scotland, added Mr. Hart, and the aim was to reach a position where 50% of the output went to industry. This would mean doubling their sales to industry in the area. For this they had completely reorganised the industrial sales organisation, taking on very experienced fuel engineers who would be giving an advisory service to industry. The organisation included a complete maintenance department who would be able to give a first class service.

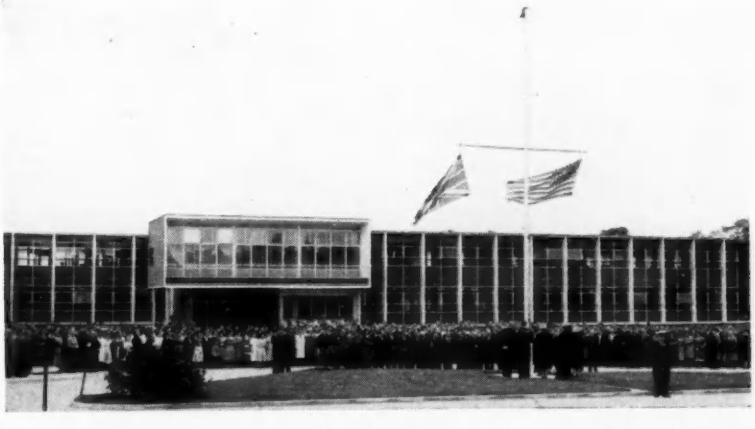
Mr. Hart said that the selling of an extra £1,500,000 of gas per year to industry could bring down the price for domestic users. At least it would stabilise domestic prices. There had always been a great inter-dependence between domestic and industrial consumption in the gas industry. Many industrialists had already placed orders for equipment although two years would elapse before they were ready for use. Some had spent up to half-a-million pounds in new equipment and furnaces.

Company Opens New Factory

THE New Factory built by Foxboro-Yoxall, Ltd., at Redhill, lies immediately behind the office block to which it is connected by covered ways. It is of single storey north light construction and is, at present, 200 ft. wide and 425 ft. long. The walls are of brick to about 4 ft. and are then of glass up to the glass and aluminium roof.

A notable feature is the absence of service lines, cables, conduits or pipes between the roof and the floor. All services are distributed through an underground tunnel which runs the length of the factory and has its main opening in the power house. Gas, water, heating and electric mains all run through this tunnel and all distribution boards, fuses and branch pipes are accessible.

Production facilities are laid out on the modern circular system whereby goods enter and leave the building at roughly the same point, the goods circulating round central storage areas. Working conditions are of particular importance in the production of high quality precision instruments and much care has gone to the creation of the best possible lighting, heating and ventilation conditions.



Pictured above is the scene last month at the official opening by the Mayor of Reigate of Foxboro-Yoxall's new factory at Redhill.

Clean Air Society Pays Visit to Dumbarton

MEMBERS of the Scottish Division of the National Society for Clean Air interrupted their annual conference, held in Glasgow on May 22 and 23, to visit the Scottish gas industry's showplace, the plant at Dumbarton. During their meetings they were told of Glasgow's 'courageous' anti-smoke plan, and reminded that Scotland was lagging in combating the smoke problem.

Mr. Ian Robertson, of the Department of Health for Scotland, said that local authorities in Scotland had been much less active than those south of the border, and there was in fact only one smokeless zone—in the Sighthill area of Edinburgh, in Scotland—although some local authorities were already securing smokelessness in their housing estates by means of tenancy agreements. The proposals being made for Glasgow were particularly important. The Corporation had planned to start with an area of 201 acres right in the centre of the city, which contained industrial, commercial, and domestic premises.

'Assuming that their Order is made, and the smoke control area set up, I do not think it is any secret that they have in mind to strike out boldly from the ground they have gained and cut across the city a great strip in which the emission of smoke will be controlled,' he continued. 'It is a courageous step, because the difficulties will, I am sure, be formidable, but certain cities in England have already shown that it can be done.' One of the associated problems in the setting up of smoke-control areas was the need to get adequate supplies and quality of solid smokeless fuels.

Coke of a high quality was the main solution to domestic air pollution, said Mr. A. Burton-Stibbon, manager of the Solid Smokeless Fuels Federation. Stocks of gas coke, at approximately 200,000 tons, were slightly higher than the corresponding period last year and were higher than the average stock level at this time during recent years. Stocks of other fuels were about normal.

If all the 'black areas' in Scotland were to be made into smoke control areas at once there would not be sufficient gas coke to meet requirements, said Mr. Burton-Stibbon, but it was unlikely that this would happen. 'One cannot at this stage visualise what developments might take place within 15 years on coke production,' he said, 'but there is no doubt that the present production could be increased considerably and the requirements of smoke control areas likely to be set up within the next few years could be met.'

Australian Gas Light Company

OUTPUT of the Australian Gas Light Company of Sydney, N.S.W., in 1957 was 42,565,091 therms of coal gas and 15,933,655 therms of carburetted water gas and oil gas, the year's statistics show. Gas purchased from refineries amounted to 27,106,644 therms, making a total available for issue of 85,605,390 therms. Gas sold for domestic consumption totalled 50,193,250 therms; for industrial consumption, 15,643,312 therms; and for commercial consumption, 7,158,804 therms, making a total of 72,995,366 therms.

Coal carbonised totalled 525,618 tons, and oil used for gas making 1,682,634 gal. Coke and breeze made totalled 352,317 tons, that used on works 221,099 tons, and that sold 134,891 tons. Crude tar made amounted to 8,694,064 gal., sulphate of ammonia, 5,648 tons.

Total number of customers at December 31 was 339,972 out of a population of 1.75 mill. in an area of 240 sq. miles.

Lighting Engineers

This year's annual conference of the Association of Public Lighting Engineers will be held at Harrogate from September 16-19, Principal guest at the Luncheon on September 17 at the Hotel Majestic will be the Joint Parliamentary Secretary to the Ministry of Transport and Civil Aviation, Mr. G. R. H. Nugent.

Municipal Treasurers

The Institute of Municipal Treasurers and Accountants are holding their 73rd annual general meeting and conference at Eastbourne this week. Among those addressing the conference will be the Paymaster - General, Mr. Reginald Maudling, M.P.

Purchasing Officers

The Purchasing Officers' Association recently held a Press reception to mark the publication of their booklet 'Terms and Conditions of Purchase,' a buyer's guide to the drafting of purchase order conditions.

DANISH GAS ENGINEERS IN ENGLAND

Members of the Board of Directors of the Strandvej Gas Company, Copenhagen, during their recent visit to the Segas plant at Sydenham with Messrs. Canning, Ward and Branch, of the South Eastern Gas Board, and Mr. W. J. Cutler of The Power-Gas Corporation.

DIVIDEND CUT AFTER 'DIFFICULT YEAR'

IN his statement accompanying the annual report for 1957, the Chairman of Drakes, Ltd., Mr. John A. Drake, says the year 'has again been exceedingly difficult for trading in the gas industry.' No large orders were placed for the building of traditional gas-making plant, although orders for repairs were equal to previous years. In view of the reduced Group net profit, £7,949 (against £10,663 in 1956), the Directors recommended that the Ordinary dividend be reduced from 10% to 5%.

Imperial Continental

Profit of the Imperial Continental Gas Association for the year ended March 31, 1958, after all charges except taxation, amounted to £1,242,650 (against £1,338,444 in the previous year). U.K. taxation takes £666,978 (£843,566), less estimated relief in respect of foreign taxation, £99,319 (£94,789). Interim ordinary dividend was paid at the rate of 3% (less tax), absorbing £193,200 (same), and final ordinary dividend is proposed at the rate of 7% (less tax), absorbing £450,800 (against 6% net, £386,400). Carry forward is £197,023 (against £166,032 brought forward last time).

GAS AT THE INTERNATIONAL EXHIBITION

PICTURED here are two views of the Pavillon du Gaz, situated in front of the reception hall at the centre of the International Exhibition at Brussels. The main aims of the exhibit are to show the importance of gas in the economy of a country, and to illustrate the new developments taking place within the industry. Gas production, transport, and distribution are illustrated with models, diagrams and illuminated panels; and to show the different utilisations of gas, there is a large array of domestic and industrial appliances, many of which are seen in operation. Total area of the gas pavilion is 3,900 sq. m. It is divided into two halls.

His Motto was 'More Light'

CENTENARY OF CARL AUER VON WELSBACH

By M. Schofield

AFTER William Murdoch had begun the history of practical gas-lighting the most striking figure in subsequent developments was Carl Auer von Welsbach, born 100 years ago on September 1. Welsbach was such an accomplished academic chemist with his successful separation processes for rare earth elements that if he had done nothing else he would have been commemorated. Yet here was a versatile inventor who applied some of his observations from rare earth studies to give us the incandescent gas-mantle; who then went on to introduce that iron-cerium alloy used as lighter 'flints'—at first in his automatic gas-lighter but later in the petrol-lighter of Mr. Everyman. Then to round off his score Welsbach became pioneer in rival electric lighting with his development of the osmium filament, all as if in support of his appropriate motto: 'Plus Lucis'—or 'More Light.'

Von Welsbach was born in Vienna and studied at the Polytechnic there before going to Heidelburg University to study under Bunsen. Since the young student had a keen interest in minerals he was encouraged to begin collections of rare earths by the German master, who also had recently invented the Bunsen burner in which Von Welsbach was to note the brilliant incandescence of thoria. The rare earths are so very similar in their chemistry and so closely associated in complex minerals that it proved a difficult subject, as indeed it had done to a number of brilliant chemists. Yet the old earth 'ceria' was finally separated into a number of single earths or oxides, into pure ceria, lanthana, neodymia, praseodymia, and others. Welsbach's striking share in the great work was to split the earth 'didymia' into praseodymia and neodymia.

Since in that memorable year of his birth the use of spark spectra of rare earths had been discovered by Willigen, and since the famous co-workers Bunsen and Kirchhoff had also developed the spectroscope for this purpose, it might have been supposed that Welsbach had been born too late to enter this field of chemistry. On the contrary he announced in June, 1885, to the Vienna Academy of Sciences his two new earths; and then only three months later took out his first patent for the incandescent lamp known in Germany as the *Auerlight*.

In his many papers Welsbach not only described his work on pure chemistry, but also his observations which brought the gas mantle. In 1880 he noted how the earth 'erbia' emitted green rays, and he decided to develop the study of such radiations. Since his little beads of substance held within the bunsen flame on platinum gave a poor source of rays for examination with the spectroscope, Welsbach hit upon the idea of soaking cotton threads in the rare earth solution, hoping that when he calcined the threads or fibres an ash or skeleton would remain to emit the characteristic radiation to be examined. Bunsen would hardly believe this would be successful, as indeed it was.

The first rare earth to suggest use on a practical scale as source of illumination was lanthana, yet this oxide soon fell to powder when left as a skeleton or 'mantle,' as Welsbach began to call the fragile earth ash. He tried therefore to incorporate a second earth or oxide to impart stability, magnesia plus lanthana being his first partial success—one lasting from 70 to 80 hours 'burning' after which the mantle acquired a translucent or vitreous consistency. So the great struggle went on, with hours of patient experiment on other oxides like zirconia. Rather early it seemed, Welsbach gave a demonstration to the Press in his Vienna laboratory, with some reports favourable and others too sceptical. One technician present sardonically remarked: 'In my works we only take notice of serious ideas.' With his many fields of work Welsbach was fully occupied; hence it was just as well that he took as collaborator M. L. Haitinger, an experimenter who noted how ceria in small proportion seemed an essential to good emissive powers for a mantle.

After hundreds of experiments Welsbach's incandescent mantle theme began to take shape when he prepared his cotton fabric of cylindrical shape, impregnated it with nitrates or acetates of his rare earths, dried the fabric and drew it together at one end with fine platinum wire (later replaced by asbestos thread), and ignited it to give a coherent skeleton later hardened. With his thoria as main earth Welsbach was almost home, while in 1891 came his 'Auer Mixture' containing ceria. Finally his 99% thoria and 1% ceria proved ideal.

His patents brought spurious efforts to imitate his success without taking up rights; claims which included such spurious elements as Lucium, Russium, Kosmium and Neokosmium. In commercialising his discoveries Welsbach met much opposition, with 'capitalists, mistaken in their hopes, becoming impatient and threatening legal action,' as he put it. A factory at Atzgersdorf which had closed down and had seen its staff of chemists dismissed, was taken up and developed by Welsbach; and there it was that he introduced ceria.

Later when he found dumps of *misch-metal*, a crude by-product of the thoria industry, lying around in his works yard; when he heard of gas-mantle manufacturers giving away a pound of crude ceria with every hundred pounds of thoria purchased, Welsbach went back to further experimenting and invented his sparking or pyrophoric alloys patented in 1903. It was found that metals like cerium when alloyed with cheaper metals like iron emitted sparks like 'flints,' the essential being to use a brittle alloy so that 'fat' sparks would be thrown out in use. The iron proportion was at first 30%, later raised to 35%, the latter alloy prepared from his misch metal being called 'Auer Metal.'

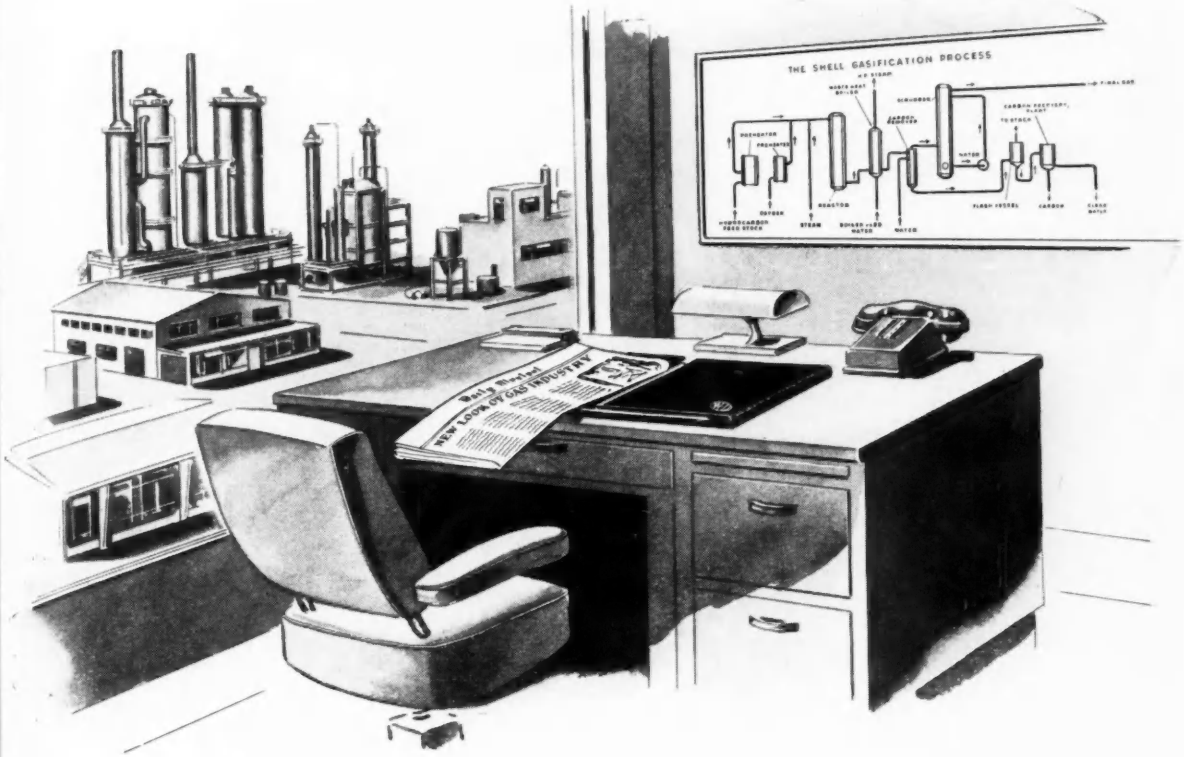
Welsbach became President of the AuerGesellschaft, a Company with 4,000 employees and with a chemical works at Treilbach. He was elected to the academies of science at Berlin, Stockholm, and elsewhere, and when he retired to Welsbach Castle he kept there his fine collection of rare earths, his spectroscope, and Bunsen's library as reminders of his years of endeavour.

B.S. for L.P. Gas Lamps

RELIABILITY and safety-in-use are essential features of lighting appliances fuelled with butane or propane gases. They are the predominant themes of B.S. 2977, Part 1, a new British Standard dealing with lighting appliances which burn butane gas (the term 'Lighting appliances' including component parts such as burners, brackets, pendants and their taps).

Six burners are named in the 'Classification' clause; and the nominal gas flow rate in cu.ft. per hour at 11 in. w.g. is specified in respect of each. In the 'Construction' clauses the quality of fittings and materials is assured by their compliance with existing British Standards, 'but other types of fittings or materials may be used provided that the standards of performance, durability and safety of the appliance are not thereby lowered.'

The requirements for lighting efficiency are related to a test (detailed in an appendix) which involves the use of a photometer and a test gas consisting of normal or *iso* butane or any mixture thereof. Of direct assistance to the consumer will be the requirement that instructions for fitting, maintenance and use shall be provided with each appliance, and that burners shall be clearly and permanently marked with the manufacturer's name or trade mark; the type number; and an indication of the gas for which the appliance is designed.



A new look is coming to the Gas Industry

Town gas still flows from the holders but the Works' skyline is changing and beginning to show the influence of Oil and High Pressure Processing. Woodall-Duckham's new High Pressure Processes Division has been formed to meet these changes and complete plants can be provided for the production of gases suitable for Town supply, etc. using modern high pressure techniques.

WOODALL-DUCKHAM CONSTRUCTION COMPANY LTD

WOODALL-DUCKHAM HOUSE, 63-77 BROMPTON RD., LONDON, S.W.3

Telephone: KENsington 6355 (14 lines) Telegrams: Retortical (Southkens) London

FLAMEPROOF

circuit control

FLP

3574 GROUP I
3575 GROUP II

For applications in hazardous locations in every industry the B.S.A. ACME SNAP-LOCK FLAMEPROOF LIMIT SWITCH has been specially developed to ensure complete protection and to enable easy installation. Moreover, its design and construction provide for long and reliable service under conditions of extreme severity.

For non-hazardous applications there is the STANDARD SNAP-LOCK, water, oil and dust proof, and equally robust for heavy duty.

They are available as single pole, double break; one normally closed and one normally open circuit (reversible by transferring the return spring) or maintaining in either position, or supplied with central neutral position and convertible to various circuit arrangements.

Let us send you further details.

★ **Buxton Certificates: No. 3574 (Group I gases). No. 3575 (Group II and III gases).**

★ **Meehanite iron castings.**

★ **Self-wiping solid silver contacts.**

★ **Interchangeable plugs and sockets.**

★ **Single SWA cable entry (standard); double entry if required.**

★ **Levers for a variety of applications.**

MADE UNDER LICENCE FROM NATIONAL ACME CO. U.S.A.

B.S.A. TOOLS LIMITED. BIRMINGHAM. 33. ENGLAND

SOLE AGENTS GT. BRITAIN:

BURTON GRIFFITHS & CO. LTD. *Snap-Lock Divn:* 93 ALBERT EMBANKMENT. LONDON. S.E. 11

TELEPHONE: RELIANCE 3891

426

B.S.A. ACME SNAP-LOCK

New Glover-West Plant at Orange, New South Wales

UNLIKE the position in Britain, where nationalisation has brought integration in its train, resulting in the closing down of small gasworks, in Australia and New Zealand there are still many isolated small gasworks, mainly owned by municipal councils, with outputs varying from 20 mill. to 100 mill. cu.ft. per annum.

Due to the great distances between country towns in Australia there is little likelihood of a gas grid system being applied and it is therefore most important for the future of the gas industry that highly efficient small gas producing plants should be developed for this market.

Up to now, most of the small country works have been equipped with horizontal retorts, many of the hand-charged type, and a few with mechanical charging and discharging equipment. As there is a good market for coke in most country districts, it is felt that future developments must employ coal carbonising plants, and it has been considered for some time that the best answer lies in simple installations of continuous vertical retorts.

The higher capital cost of continuous vertical retorts is offset by the saving in operating costs, depending largely on the saving in labour. The Australian workers' unions, which are very strong, have always opposed the principle of a plant being operated by one man, mainly on safety grounds, and until the Orange plant was installed and it was proved that one man could easily operate the plant, efforts to get continuous vertical plants installed always failed.

The City of Orange is situated some 166 miles west of Sydney and is the main town of the Shire of Canobolas. It is approximately 3,000 ft. above sea level and is subject to severe winter conditions of heavy frosts with snow, while in summer it can be very hot and dry from November to March.

Gas was first made available in 1877 by the Orange Gas Company, who sold out to the Borough Council in 1888, the original plant being two settings of six stop-ended hand-fired horizontal retorts. Output was some 6¼ mill. cu.ft. per annum and the selling price a flat rate of 17s. 6d. per 1,000 cu.ft.

By 1910 there were 77 gas lamps and output had increased to 20 mill. cu.ft. per annum, a steady increase being made until 1923 when the street lighting was changed to electricity.

In 1926 the demand was 32 mill. cu.ft. per year and there were 24 stop-ended retorts built in four settings. Further progress was made until 1940 when a small arms factory was established and a direct 6-in. low pressure main laid. A fifth setting was added to cope with the demand which reached 50 mill. cu.ft. per year.

By July 1946 the population had grown to 15,000 and Orange was proclaimed a city, the district population being 30,000.

In 1952 came the commencement of laying of high pressure mains and installation of five high pressure storage cylinders, with the carbonising plant comprising six settings and demand slowly but steadily increasing.

In 1953 the Council discussed proposals for future carbonising plant and on July 20, 1955, a contract was signed for the installation of a new Glover-West plant of modern vertical retorts with coke plant and waste-heat boiler.

The new plant started to make gas in early June 1957 in time to meet the winter load, and on June 15 was handed over to the Council as represented by the Mayor (Alderman A. Ridley) and the Chairman of the Gas Committee (Alderman L. Cassey).

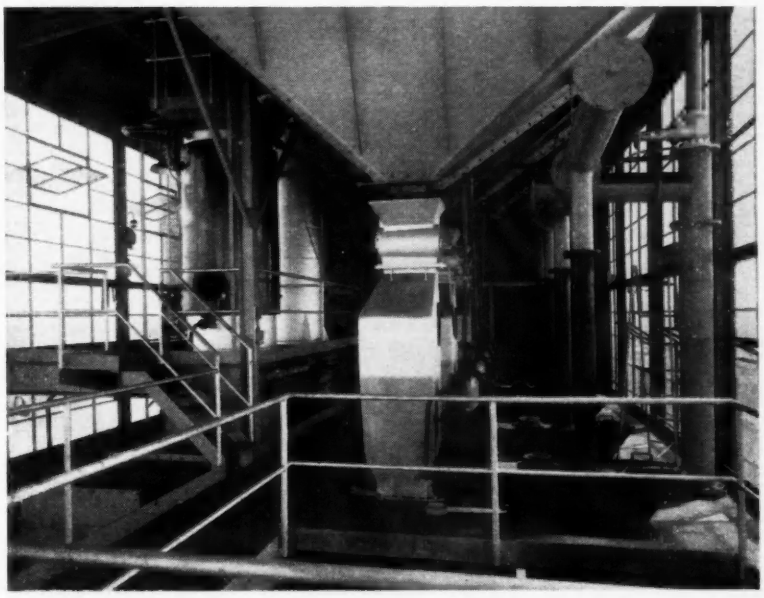
The building has been designed, in conjunction with the Orange City Council's architects, of brick and steel construction with large horizontal windows, steel framed and glazed with non-actinic glass, a feature being the chimney tower glazed to roof level, making best possible use of daylight. At night the installation is well lighted artificially throughout.

Each of the four platform levels is served by the electric goods and passenger lift with a carrying capacity of 3,000 lb. operating at a speed of 125 ft. per minute. In addition to the lift, the entire plant is served to each stage by easy and spacious stairways.

Mess-room and washing facilities are provided in a house adjoining the retort house with the usual facilities for the day staff and the one man on shift.

As the plant is normally operated by only one man on shift, the lift has been provided with an individual telephone on an external line so that any breakdown can be quickly reported during the day or night.

It is interesting to note that the industrial and hot water tariff in 1957 is 17s. 6d. per 1,000 cu.ft. just as it was in 1888.



At charging floor level, showing coal boxes, gas offtakes and the waste-heat boiler. The very high standard of natural lighting is most noticeable.

The carbonising plant comprises four 50/56-in. Glover-West continuous vertical retorts built individually with an air-cooled insulating wall between each retort and its neighbour. They are rated to produce 335,000 cu.ft. of gas per day from the western coals of the Lithgow valley, when making gas at a calorific value of 511.8 B.t.u. per cu.ft. Provision is made within the retort house for a future extension of two retorts.

The retorts built in siliceous materials of Australian manufacture, are heated by fuel gas produced in one of two step-grate producers. Combustion in the heating flues is controlled by fixed-orifice nostrils adjusted to give steady pressure and temperature conditions.

The foundations for the retort bench are supported on timber piles driven to a depth of from 25 to 30 ft.

The sensible heat remaining in the waste gases leaving the retort setting is recovered in a Spencer-Bonecourt natural draught tubular boiler raising steam at 120 lb. per sq. in. The boiler is equipped with an automatic water feed with alarms giving warning at either high or low water levels, feed water being supplied by one of two steam driven vertical pumps, each capable of delivering 180 gal. of water per hour against boiler pressure.

The railway siding runs alongside the non-producer wall of the retort house and coal is taken direct from the wagons by means of a small mechanical shovel and fed directly into a small coal receiving hopper and through a single roll coal breaker, capable of crushing 10 tons of coal per hour from 6-in. to 2-in. cubes. From the breaker, the coal is fed into a receiving hopper and then into the mobile coal wagon for elevation in the electric lift to the overhead coal storage bunkers. These bunkers have a storage capacity equivalent to 48 hours coal supply.

Coke is discharged in a cool condition from the retorts into a skip for elevation in the electric lift to the bunker platform where it is fed into a shoot and directed either into the producer feed hopper or to the coke screening plant. The screen consists of a double deck vibrating unit to receive the run of retort coke and separate it into three coke storage compartments, the grading being over 1½ in., 1½ in. to ½ in. and ½ in. to 0 in., the total storage capacity being 50 tons.

For internal use the run-of-retort coke in the producer feed hopper is fed over a static debreezing screen and then direct to the producer. A compartment is also provided to feed coke at top of stack level for retort charging after scurfing.

The new gas-making plant at Orange described and illustrated in this article is also somewhat novel because it is the first continuous vertical retort plant to operate on New South Wales Western coal.

Many U.K. readers, while having heard about the very rich Maitland or Greta seam coals of Australia, may not realise that in the vast Commonwealth of Australia there are many other rich coalfields. The Western coalfield of New South Wales is one of these, but due to the high ash and low volatile content compared with that of Greta seam coal the Western field coal has not been widely adopted for gas-making purposes. The proximate analysis of the two coals is approximately as follows:—

	Greta Seam	N.S.W. Western
Moisture ..	2%	2%
Ash	8%	15%
Volatile Matter	40%	32%
Fixed Carbon ..	50%	51%
Swelling Index	4	1

For many years past the majority of Australian gas undertakings have used the famous Greta seam coal for gas production, but the steady rise in the cost of winning this coal, plus substantial increases in freight costs, has forced some undertakings to use coals, not previously considered suitable, from their nearest source of supply. Melbourne with its changeover to brown coal being the most notable example.

The City of Orange is situated close to the N.S.W. Western coalfields and naturally it was decided to use the Western coals. The main problem was, would the low swelling Western coals produce a coke suitable for sale in the local market. The answer to this problem has been proved to be in the affirmative. The coke produced although somewhat friable is extremely reactive, the analysis and grading being as follows:—

Proximate Analysis.

Moisture	6%
Ash	21%
Volatile Matter	2%
Fixed Carbon	71%

Grading (Screening Plant Fixtures).

Over 1½ in.	37.1%
½ in. to 1½ in.	47.5%
Under ½ in.	15.4%

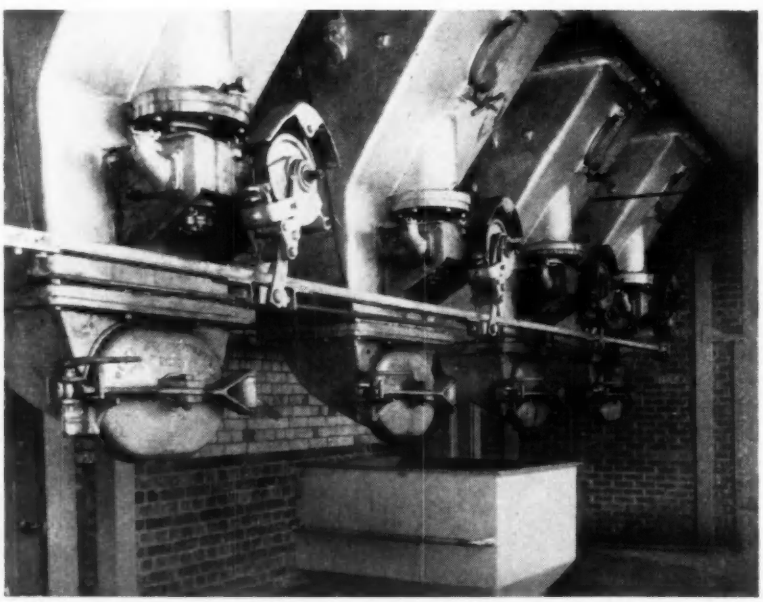
Performance tests on the new plant have been carried out under the supervision of the New South Wales Government Principal Gas Engineer's Department and, although corrections were necessary due to portions of the plant being out of commission due to sudden fall in gas demand, the tests indicate that the plant is capable of producing the following results:—

Make of gas per ton of coal:—
15,500 cu.ft. at 526 c.v.

Yield of coke and breeze for sale with all heated retorts working 9.9 cwt. per ton.

Yield of coke and breeze for sale with two retorts working and one off under heat .. 7.7 cwt. per ton.

No accurate figures for tar production could be obtained during the test.



The coke chambers, showing the extractor gear and the coke skip.

GAS ON THE CONTINENT

TUNNEL DRILLED UNDER THE RIVER SAAR

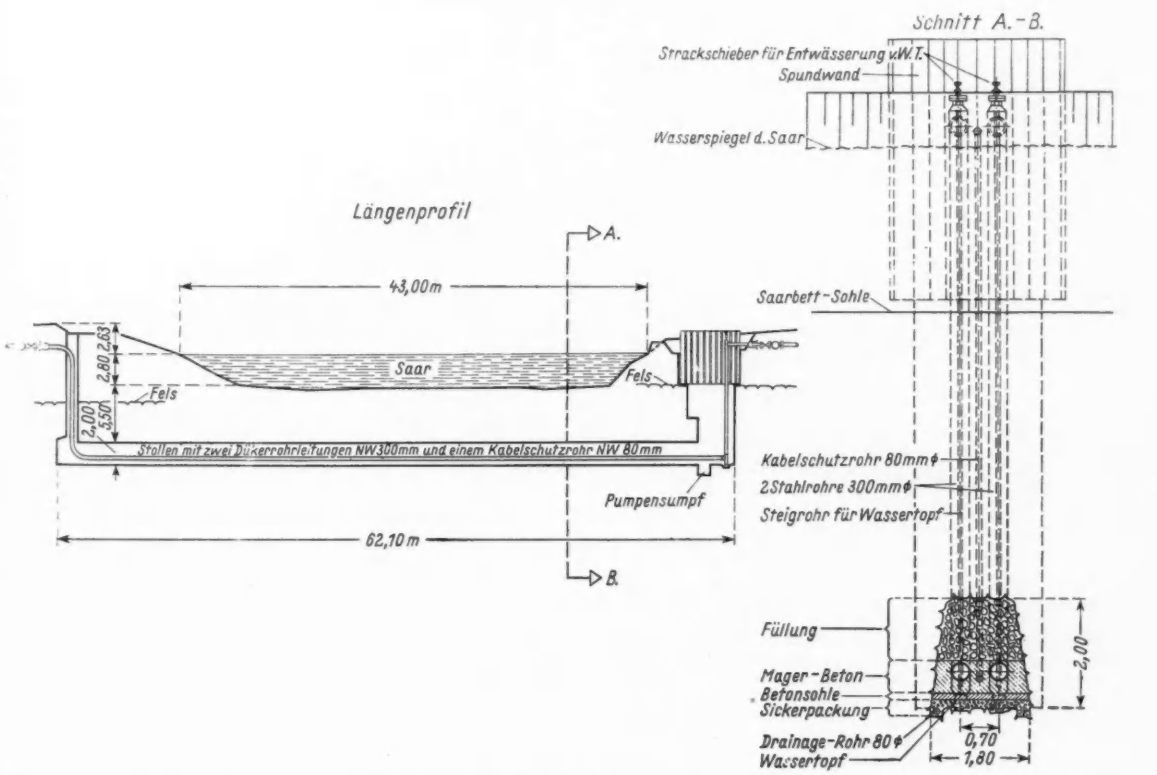
THE Saar-Ferngas AG. has greatly increased its gas output in recent years. Among its new developments was the crossing of the River Saar close to the French frontier. Unfortunately, no bridge was available for crossing of the river and the building of a pipe bridge would have seriously interfered with the scenery. It was also considered advisable to remove the pipe from any possible external influence. The laying of a siphon in the Saar would only have been possible with great difficulty since the bottom of the river was compact sand-stone. It was therefore decided after boring tests, that a tunnel would be driven under the 50 m. wide navigable river.

The solid sand-stone is particularly suited for tunnelling—particularly if it proved to be sufficiently impermeable to water and free from faults. The work was therefore given to a local tunnelling contractor and a start was made at the end of June, 1957, with the vertical shaft. Sheet piling walls 5 m. deep, enclosing 3½ m. by 5½ m., were driven to the rock and the earth removed inside. The rock was then drilled and blasted over an area of 2.2 m. by 4.4 m.

Below the top strata at 7 m. depth, a 20 cm. thick water bearing sand layer was met which had to be pumped out at 6 cu. m. per hour. The water flowed into the shaft both from the river and from the landward side, as could be seen from an 8°C. difference between their temperatures. This was also proved by water analysis. Towards the end of August the vertical work was completed to a depth of 12.3 m. The water in-leakage had risen to 50 cu. m. per hour through the porous sand-stone and small cracks in the shaft. In order to accelerate the work it was now carried on in two shifts, day and night. The dampness of the tunnel wall fortunately decreased as the work progressed.

After 50 m. tunnelling towards the opposite side of the Saar, a 30 cm. thick sloping strata of sand and a 5 cm. thick clay layer were met. This showed that the conditions underground were much more complicated than had been originally assumed. From here on, the tunnel required supporting. The horizontal workings reached the left bank of the Saar by the middle of September. At the same time, a 1,000 mm. diameter steel tube was sunk vertically into the ground down to the rock at a depth of 6.3 m. and this was met by the horizontal tunnel after 57 m. Pipes, two of 300 m. diameter and a cable pipe of 18 mm. diameter, were laid in the tunnel. These pipes had to be cut into 6-7 m. lengths to enter the tunnel from the vertical shaft. They were electrically welded and double insulated with neobitumen binding. The end of the vertical pipe at the right bank was formed as a water trap.

The finished siphon was pressurised with 56 atmospheres water pressure and 6 atmospheres air pressure. Finally, the siphon was filled with sand to 20 cm. above the pipes, then a 30 cm. thick concrete slab, and finally back-filled. The siphon is no longer accessible but since two pipes have been laid, either of which can undertake the required throughput, reliability is ensured. As with the whole of the Saar H.P. gas distribution, the network is cathodically protected.

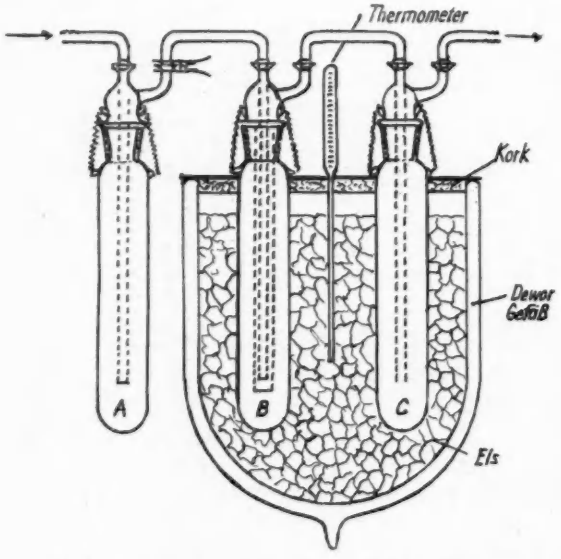


Section through the tunnel. Längenprofil, *longitudinal section.* Stollen mit zwei Dükerrohrleitungen NW 300 mm. und einem Kabelschutzrohr NW 80 mm, *horizontal gallery with two siphon pipes 300 mm. bore and one cable protection pipe 80 mm. bore.* Strackschieber für Entwässerung v.W.T., *valve for dewatering the water sump.* Spundwand, *sheet piling;* Wasserspiegel d. Saar, *Water level of the Saar;* Saarbett-Sohle, *river bottom (solid);* Pumpensumpf, *sump for pumping;* Kabelschutzrohr 80 mm., *cable pipes 80 mm. bore;* 2 Stahlrohre 300 mm., *2 steel pipes 300 mm. bore;* Steigrohr für Wassertopf, *riser from water sump;* Füllung, *back-filling;* Mager-Beton, *weak concrete;* Betonsohle, *concrete slab;* Sickerpackung, *filter packing;* Drainage-Rohr 80, *drainage pipe;* Wassertopf, *water drain sump;* Fels, *rock;* Schnitt A-B, *section A-B.*

Determining the Naphthalene Content of Gases

THE naphthalene residue in coal gas assumes greater importance with the extension of gas supply lines because of the increased risk of blockage when the gas is compressed. The article describes an apparatus for determining the naphthalene content, which is an improvement on the apparatus of Zwieg-Kossendey and Seebaum-Krecke. It offers a simple, portable apparatus made up principally of standard components and uses only one Dewar flask instead of three. The apparatus consists of three identical special wash-bottles of a novel and compact design. Referring to the figure, the first flask A is filled with sulphuric acid, to remove the ammonia, and is located in a pocket in the protection cover of the Dewar flask—the pocket being provided with slots to permit the gas bubbles to be observed. The second wash-bottle B, which contains the picric acid solution, has the inlet tube insulated by a sleeve to prevent freezing of the naphthalene crystals in it. The flow of gas should be maintained at 80-90 litres per hour to avoid this freezing. The third wash-bottle C acts similarly to B to remove the last traces of naphthalene. The clamps on the connections are omitted in the illustration for simplicity. The ice filling, evaluation, etc., are identical with that of the earlier known apparatus. Among the advantages claimed for the new design of apparatus is that of a zig-zag arrangement of the connecting tubes, which the special wash-bottle permits, enabling the apparatus to be made particularly compact. It is also suggested that a wide use can be found for these wash-bottles in other fields.

P. Hofmann. Das Gas-und Wasserfach. Vol. 98. No. 43. October 25, 1957, p. 1081, 3 pp., 5 ff. 2 t.



Kork, *Cork;* Dewar-Gefäss, *Dewar Flask*; Eis, *Ice.*

Waste Heat in Gasworks Coolers

HEAT economy is a predominant financial criterion of a gasworks. The highest costs are incurred in the heat requirements of the retorts, the generators, and the boiler house. The retorts require for firing a heat input of 10-13% of the coal consumed. Approximately one-fifth of this, *i.e.*, 2% of the heat needed to gasify the coal, is carried to the condensers as sensible heat of the coal gas, and is there transferred to the cold cooling water. In modern cross-tube condensers the water flow is from bottom to top, and is divided into sections. The cooling water normally enters from the bottom into one of these sectors and flows through these in series, to emerge at the top at the highest temperature (approx. 40°C.) permissible on the grounds of deposition of hardness. If a separate supply of water is made to enter the top two sections only, an outlet water temperature of 70°C. or higher with a normal gas outlet temperature of 80°C. may be obtained.

An example of this is the pre-heating of boiler feed-water in a gasworks. A daily throughput of 150 tons of treated feed-water enters the top section at a temperature of 10-20°C. and is heated to 70-72°C. The saving in fuel so obtained is so large that the capital costs of the whole cooling plant can be amortised in a few years. Another example is where treated softened water is circulated to heat a large factory. The water is circulated by a small pump through the top sections and heated to 70°C., the return from the central heating system is 50°C. In order to avoid deposition and corrosion the circulated water is, of course, treated with suitable chemicals.

G. Geisselbrecht. Das Gas-und Wasserfach. Vol. 99, No. 5, January 31, 1958, p. 119, 1 p., 1 ff.

Portable Gas Fire Connections

MANY efforts have been made in recent years to provide safety gas hoses for portable gas fires, the most important characteristic of which is the provision of metal screwed connections at both ends. Further, the supply cock is so made that it cannot be opened unless the hose is correctly connected to it. To help the housewife the connection to the supply cock is tightened by a wing-nut, which enables this end to be unscrewed by unskilled people without the use of tools. The tube itself is of plastic gas-proof material with an internal spiral metal tube.

W. Krauel. *Heizung-Luftung-Haustechnik*, Vol. 8, No. 7 July, 1957, p. 180 1 pp.: 2 ff.

Drifting Snow Capsized Three Copenhagen Gasholders

DURING last winter's snow storms the Copenhagen gasworks suffered a most unusual and dangerous catastrophe. On the crowns of the large gasholders the snow lay in such large quantities, on one side, that three gasholders 'capsized'; two at Valby and one at Eastern gasworks. Water-seals were distorted by the pressure and a great amount of gas escaped.

At Eastern gasworks the heavy steel girders in the gasholder's framework were bent into curves and as the holder was pressed down on the one side, the water-seals broke and gas in great quantities escaped. Approximately 25,000 cu. m. of gas was lost before the accident was discovered.

The construction of the holders is generally so stable that it can withstand a normal pressure of wind and snow but the quantity of snow which beat down upon the whole country on February 10, was more than even the most solid gasholder could withstand. Furthermore, the snow drifted so badly on the crowns of the holders that one side was pressed down. Although the gasholder that went over at Eastern gasworks could hold 50,000 cu. m. there were only 15,000 cu. m. in it when the accident happened.

It was estimated that the repairs of the damaged holders would take a few weeks but, together with Valby gasworks, gas demands were met without undue difficulty. At Valby gasworks the snow pushed two gasholders crooked but there was not much damage and the repairs could be carried out on the spot. Valby gasworks holders are still larger than the one which was damaged at Eastern gasworks. They can hold 125,000 cu. m. of gas but, fortunately at the time, there was only 45,000 cu. m. in them when the snow on the crowns pressed the water-seals out of position and gas began to escape.

At Valby gasworks it is estimated that 15,000 to 20,000 cu. m. gas were lost, considerably more than escaped from the accident to the smaller holder at Eastern gasworks, but altogether the whole unusual accident cost approximately 25,000 cu. m. of gas. In comparison with Copenhagen's daily gas consumption that is not a great amount, said Engineer Jörgensen, of Valby gasworks. The Copenhagen daily consumption lies around 400,000 cu. m. but the accident was quite unusual. We were no sooner out to do something about it than the snow storm returned We discovered that the water-seals were distorted and it was quite clear to us what must have happened so, as quickly as possible, we shovelled the snow from the crowns of the gasholders. Fortunately the damage was soon put right and we kept the holders in operation.

Land og Folk, Febrary 13, 1958, and *Gasteknikeren*, Copenhagen, March 21 1958.

An abstract from a paper to the Eleventh Annual Conference of Incorporated Plant Engineers, Brighton, May 14-16, 1958

Industrial Progress and the Plant Engineer

By L. LANDON GOODMAN, B.Sc.(Eng.), A.M.I.Mech.E., A.M.I.E.E.
THE BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION.

THE first and obvious development in industrial progress which has been gathering increasing momentum is mechanisation and by mechanisation is meant the replacement of manual and mental energy by mechanical and electrical energy. In many companies mechanisation has been fairly well developed, yet over the whole of British industry much remains to be done. Visits to factories support this view which is confirmed by the relatively low figures for horse-power available per worker. Improving mechanisation is obviously the first step to automation and upon the rapid development of automation will depend the expansion of British industry. The first step along the road to automation is to apply more power to the remaining hand operations or routine mental activities. Much labour is spent in tightening bolts or on small operations which can be done much more quickly, easily, and productively by an electric power tool. Many other manual operations can be quoted which are suitable for mechanisation, including the loading and unloading of lorries and the lifting, clamping and feeding of material. The next step is to apply more power to existing processes, to increase their speed or to put individual motor drives on plant and machines. At this stage, automatic feeding and unloading of the machines and processes can well be introduced. The individual drives can be tied together so that they are co-ordinated electrically, either automatically or semi-automatically. Having achieved this state it is not difficult to make the process operate continuously with the material from one process flowing automatically into the next. The final stage is to apply feed-back so that the machines regulate the quantity and quality of their output automatically.

But running parallel with mechanisation of physical labour is the mechanisation of routine mental work. Routine working and low level decision-making can well be mechanised both on the factory floor and in the office. Indeed automation now appears to be proceeding more rapidly in the clerical than in the manufacturing field. The degree of mechanisation is indicated fairly directly by the horse-power per employee and indirectly by the financial ratios of capital to wages per year and by the high value of fixed assets relative to total assets in company balance sheets. There are wide differences in the horse-power per worker figure between various kinds of industries, but there is a close positive correlation between horse-power and value of output per head in manufacturing industry. These results show an existing state of affairs but they do not explain how the state of affairs came into being —there is thus another aspect to national output.

Production and Electrical Output

Recent research in the United States of America has shown that a close relationship exists between the gross national product, the electrical output used by industry and the number of professional engineers in industry over the period of 1910 to 1950. Statistics also indicate that this country has fallen and continues to fall behind the United States in productivity. Our capital investment since the war has been in line *pro rata* with that of the United States, yet we have not obtained anywhere near the same plant productivity. Several reasons may be responsible. One is surely the relative paucity of technological knowledge in British industry as compared with United States' industry. Has the installed plant been as efficient and as well planned as it might have been? Has there been sufficient technological knowledge in management to take full advantage of all modern trends and developments? Has a sufficient percentage of capital expenditure been spent on research and development in the production fields? These questions are some that will spring immediately to mind, but the main factor of importance that comes out of our brief consideration is that spending money—even high capital investment—does not always bring the optimum output. Something else is necessary and I suggest that the two facets that still require most study are management training and development and an increasing number of professional engineers and technologists in industry. It does appear to be a matter of vital importance to increase the number of professional engineers and technologists engaged in production and management as opposed to research.

Multi-shift Working

With high capital investment, which results from modern developments such as automation, multi-shift working becomes of great importance. It seems to be madness to scrape to the bone nationally to save money through budget surpluses and privately through individual savings in order to invest in buildings, plants, machinery, roads, power stations, etc. etc., which are only used to their full extent for eight hours of the day or forty hours a week out of a possible total of one hundred and sixty-eight hours. Double-day shift working surely must come for we just will not be able to find the money to invest in industry for a plant utilisation of 25%—nor will we be able to compete with countries which are on a 50% plant utilisation basis. Consider some of the advantages of a double-day shift system in comparison with a single-shift system:—

Much lower capital savings reduce the inflationary effect of capital investment.

For a given annual output only about half the plant is required.

Because half the capital investment is being worked twice as hard, the plant and equipment can be replaced much sooner by more up-to-date and more productive equipment producing products of the latest design.

Public utilities and services are used more efficiently, again reducing the investment required for renewals and expansion.

There are, however, points that can be raised on the other side of the balance sheet, particularly social and family questions. However, if shift working is to come to this country shops, cinemas and other public amenities must fall into line, and surely the time for industry to campaign on this matter is now! While I am aware that it is not a good argument to judge the customs and creeds of one country against those of another, mention must be made that where other countries, such as the United States, have double-day shift working the high productivity and resulting high wages do much to make this system acceptable.

Emphasis must be on simplicity of equipment, which is the keynote of good planning—particularly today when equipment becomes more and more complex. A change of product design, of plant layout, even of processing can often allow a simple piece of equipment to be used resulting in increased productivity, reduced capital expenditure and reduced maintenance. One company in the pharmaceutical industry making a number of different products could not take the risk that bottles and phials might become mixed on their production lines. They decided that they required a label-reading machine to scan the labels automatically. Now automatic reading machines are expensive and complex pieces of equipment and have many valuable uses, but reading labels is not normally one of them. A far simpler solution is to have a mark on each product label printed in a unique position. A photo-

electric device can then detect the presence or absence of the mark and if a wrongly labelled product comes down a line it will be removed automatically from the conveyor.

Broadly speaking, most production operations can be divided into mechanical handling, processing, sensing and control. These four functions are closely interrelated and planning must proceed with the idea of integrating them as far as is economically and practicably possible (often this can be assisted by changing the design of the product). Electricity helps considerably in achieving this end. To take a simple example. The best way to handle goods is not to handle them, and electrical methods often eliminate the need for costly movements because they can be applied in the production line itself. An equipment which well illustrates the modern trend in integrating successive processes in the production line has recently been installed at Ford's Dagenham Works. It comprises a 25-kW. induction heater for shrinking starter rings on to flywheels, and also hardening and tempering the ring teeth; it incorporates hand-loaded, twin-station, automatic handling equipment, dealing with two rings simultaneously. Previously rings were hardened in the heat-treatment shop and the ring and flywheel were then assembled in another location. The new equipment has an output of 70 parts an hour with one operator, a 50% productivity gain on the old method which in itself was automatic, but which required two operators. This is an example of process integration—an excellent way of reducing costs and increasing output.

Costs of a Human Horsepower

The important contribution made by electricity to higher productivity has received considerable attention; but even today it is open to question whether the full importance of the electrical contribution to industrial productivity is, as yet, as widely realised in industry as it might be. For instance, is the ratio of the comparative costs of a human horse-power hour and an electrical horse-power hour generally known, appreciated and acted upon? This ratio, of about 400 to 1, is indeed a signpost to cost reduction and increased productivity. Again, the trend in the costs of energy is illuminating. From 1924 to 1956 the number of industrial kilowatt hours purchasable at the cost of an average industrial man-hour increased from 11.2 to 40.6 (in 1938 it was exactly half, namely, 20.3). In the United States this figure has risen from 39.1 in 1924 to 220 in 1956. It is of interest to note that the United States figure is about four to five times the corresponding figure for the United Kingdom, and also that the horsepower at the workers' elbow in the United States is about four times that at the British workers' elbow. These figures illustrate that electrical methods generally show a distinct economic advantage over manual methods. However, over and above this basic comparison, certain further advantages result when electrical methods are introduced—for example, increased speeds of working, improved methods of materials handling (for example, much larger and heavier loads can be moved at one time and stacked to greater heights) the possibility of the introduction of automatic control and new methods of processing. Suffice it to say here that never should the industrial worker be starved of electrical power at his elbow. Poor lighting, the absence of an electric pulley-block or of an electro-magnetic clamp—each can lower a man's output and make the job so much harder, needlessly harder. How, too, can any workman compete against a tape-controlled machine tool in circumstances that favour the use of such equipment?

It is in this context that a few words must be said about back pressure and other types of private electricity generation as opposed to taking a supply from the public authority. It is impossible to generalise on economic considerations, each case must be considered individually. However, there are several points that should be mentioned here. Electricity generation is now a specialist function—modern large power stations can be looked upon as almost automatic factories burning coal of low grade and producing electricity. Thus much specialised technological knowledge and experience are employed. A factory or works should primarily confine its attention to producing its own specialities; over-diversification of products results in a 'stretching' of management over more functions than it can efficiently control with a resulting loss of supervision. Again, most companies can achieve a higher return on capital invested in plant producing a specialised product than in plant providing services, such as electricity. The highest return on capital is something that is much to be desired. Capital locked-up in private generating capacity can be poorly remunerative. Many of the steam/electric private plants require a certain optimum balance between steam and electricity. This balance can restrict the development of electricity 'at the workers' elbow' which we considered briefly above. Many examples could be quoted where private generation has done much to restrict increased production. In a Scottish paper-mill, for example, the electrical loading was determined entirely by the engine capacity, so the lighting had been neglected. The covered loading bay, about 100 ft. long, was lighted by three 60-watt lamps. This set the standard for the rest of the plant! Mechanisation of materials handling had consequently been neglected and so had a number of other industrial engineering aspects. The result—a stagnation of production and output, and loss of competitiveness. The electrical load must surely grow year by year in any factory. Hence, if a generating plant is of the right size today it must be inadequate in the near future and vice-versa—if a sufficient capacity is put in to cover future expansion it means that capital is not being fully employed at the present. Finally, there is the question of interest rates and the advent of nuclear power. Sir Christopher Hinton stated in London in March, 1958, that if the development of nuclear power stations could be continued at the present pace, and if the upward trend of coal costs continued, nuclear power would be cheaper than that from oil- or coal-fired stations by 1962. By 1982 the cost of power from nuclear stations could be expected to be less than half that produced by power stations burning conventional fuels. There are a few instances when back pressure generation is economic, but even in these cases industrial managers are well advised to have a supply of electricity also from the public authority. Thus they ensure that there is no possible restriction on placing 'electrical slaves around the plant' or on the introduction of new technological advances.

Adequate factory wiring is a 'must' in 1958. Layout of plant is not, or should not be, static. New electrical processes and equipment are being introduced regularly and require a flexible and increasing power network. When a plant rewiring scheme is under consideration it is most advantageous to make sure that it has ample capacity. It will be found that a scheme of double capacity will cost little more than one just meeting present day demands. Costing or other efficiency calculations are sometimes taken over too small a part of the production process. If the running costs of two different types of equipment both doing the same job are compared, at first glance it might be found that plant A is cheaper to buy and/or to run than plant B. But if the costing is taken backwards to cover prior requirements and forwards to cover post-requirements for each equipment the position might be radically different.

One of the latest plants which demonstrates the quiet revolution which is taking place in world industry and which involves moving still further from hand assembly methods to mechanical processing and assembly is at the Motorola Plant where radio sets are now made almost wholly by machine. Some details of the automatic equipment making the circuit board in this plant are of interest. Automatic off-set equipment prints up to 50,000 circuits a week.

Design for Automatic Assembly

The design of the parts of a product must be carefully considered from viewpoint of automatic assembly.

Nearly all the equipment for automatic assembly operation is specially made, though standard machine units can be incorporated and both rotary and in-line types are on the market. Some assembly machines only perform a single operation and thus have to be used in large groups. Others utilize rotating tables or shuttles to carry parts between several work points carrying out a sequence of operations. Automatic assembly is only just beginning in British industry today. How rapidly it will develop will depend upon competition, markets, labour rates, technological skill and knowledge, and capital available for investment. Flexibility in the finished product can be achieved with automatic control. An interesting example is in the electronic industry. A two co-ordinate system controlled by punched tape automatically positions circuit boards beneath a drilling and a component inserting head. A pre-set

pattern is followed as holes are drilled in one board while components of pre-selected values are inserted in the board drilled during the previous cycle. Storage chutes feed on to a conveyor as many as 24 different components that takes them to the insertion head. Sometimes the fabrication and assembly operations can be combined—an obvious advantage. Wire racks for automatic dish washers are made at the rate of 170 units per hour in an automatic forming and welding machine. Wire is drawn from bulk reels to form a continuous strip of longitudinal and cross members. Wire is cut, formed and welded as it is transferred through the machine. Reserve reels are butt-welded to reels feeding the machine to make the operation continuous. Automatic operation is making considerable progress in the welding field. A spot-welder making 24 simultaneous spot welds on a luggage boot door permits an entirely automatic sequence and can complete up to 300 sub-assemblies per hour.

Process Integration

There are a number of ways of achieving process integration and automatic working; one of the most useful is to change the method of processing and this can often be done by redesigning the product. The classic example of this method is the printed electric circuit referred to above. It would be virtually impossible to mechanise the wiring operations that have to be undertaken in building up a radio or television set chassis. Thus the only way to solve the problem is to return to the beginning and produce a design which *can* be processed automatically. The designer and inventor who produced the printed circuit produced such a design. Welded-up pressings may be the answer to one problem, electro-polishing to another and so on. It seems that there is no limit to the number of operations which can be made automatic. But again it should be stressed that progress in this field mainly results from development work of a high order. Individual and group inventiveness are both required, but progress may well often result from close collaboration between a number of people including the designer, the research man, the production and plant engineers, the electrical engineer and so on. It is well known that it is not always easy to obtain the (or even a) solution to a problem and in any budgeting much time must be allowed. High costs incurred in industrial processes are not always considered as carefully as they might be. In the finishing and painting of office furniture the cost of finishing per super foot may often be much higher than that of the basic material. Electrical methods here play an invaluable part. Hot spraying eliminates 'orange peel' effect. Electrostatic paint spraying and detearing save paint, make the operation automatic, and speed the work as well as improve the finish. Developments are afoot in this field. Already there is plastic covered steel sheet (vinyl clad) on the market which can be pressed, formed or welded. Steel can be given a textured finish, in some cases a deep-textured finish proves most effective. The trend thus is to work the 'finished' material so that no further finishing operations are required after fabrication and assembly. It is of interest to note that this idea is not new for it has been used for many years in tin-box making.

Plant engineers will be well acquainted with various non-destructive methods of inspecting and testing materials, such as X-ray, gamma ray, ultra-violet ray, ultrasonic and magnetisation techniques. Small portable ultrasonic thickness measuring equipment is most valuable for determining the thickness of boiler plates. The trend in testing is to mechanise the inspection methods. A good example is the semi-automatic ultrasonic flaw detectors which are being used in Birmingham for the scanning of light alloy plates and various forms of extrusions. A tank, 40 ft. by 4 ft., is filled with water. A crystal probe is fixed under the water, to the end of a vertical column which is moved longitudinally by a motor drive. At each end of its travel a lead screw moves the probe through a pre-determined distance across the tank to start a fresh journey. In this way the material in the tank is completely scanned. The pulses from the probe produce four peaks on the screen of the flaw detector. One peak occurs at transmission, a second one on reflection at the top surface of the specimen, and a third on reflection at the bottom surface. A flaw inside the plate will produce a fourth peak between the second and third. Two monitors, giving audible warning signals, are incorporated. If it is at all possible, inspection and testing should be carried out in the manufacturing process itself, so that the results of the inspection can control the process. Of course, this cannot always be done but it remains a worthy objective.

The long history of control techniques is something we have heard about many times recently. People have traced feed-back principles to the windmills of the Middle Ages or to desert chariots of Biblical times. All this is extremely interesting but somewhat disconcerting when it is realised how little automatic control is used in industry today—particularly automatic control with feed-back. Nevertheless, instrumentation and control are being used on an increasing scale, although there are many people who would like to see a greater impetus in this direction. It is another field which is in its infancy but which by present-day standards will show amazing developments in the future. It is interesting to note that it has been estimated that the cost of complete instrumentation of a new plant, automating it as fully as possible, is, taking an average for all industries, 6% of the total investment in plant and equipment. However, this additional cost can easily be outweighed by capital economies in other directions. Before any control, manual or automatic, can take place, some form of measurement must be installed. A good general rule is that what can be measured can be controlled. Therefore, the requirements of a control system are: a sensing head, a control and information centre, and a programme of the desired results with which the observed results can be compared. The difference between the two, the error, serves to actuate the controlling mechanism, called the actuator. Electrical and electronic techniques have a most important part to play. They provide powerful sensing methods, simple communication channels, complex control systems, many types of actuators, and the unique advantage that they can be simply and easily connected to, and tied in with, an electronic computer or data processing system. Good instrumentation, even without automatic control, can do much to improve industrial efficiency. For the best results with automatic control it is usually desirable to design and build the plant with the control equipment as an integral part rather than hang on control devices as an after-thought.

In the paper-making industry, already well established in the newer mills is the beta gauge weight measurement control which uses radio-isotopes to scan running paper and automatically sends impulses to machine controls, automatically correcting errors and assuring a uniform product, a vital factor in mill production. It has been estimated that this device alone can add as much productive capacity as the installation of a new machine, *without additional manpower.*

Isotope Measuring Devices

These isotope devices can be used for the accurate non-contact measurement and control of thickness or substance of sheet materials and coatings. Gamma-ray instruments have the outstanding feature that they can operate entirely from outside a vessel and are admirably suited to on/off level control at a fixed level or continuous indication over a short range. One of their latest uses is the maintenance of the level of molten glass in the channels which feed the automatic machines for bottle-making. Much progress has been made in the industrial applications of punched cards and punched and magnetic tapes. A new special-purpose automatic system in which punched paper tape controls a complex chemical manufacturing process has recently been developed. An automatic weigher, a liquid metering system and arrangements for setting a standard-type temperature controller from punched tape are incorporated, and an advanced type of in-line digital display unit provides progress indication. The products concerned are similar in character but vary in composition, processing temperature and processing time. Computer control has been much in the news. Now, one of the latest applications is a computer controlled flame-cutting machine which can shape and profile automatically steel plates for shipbuilding, tanks and vessels, the preparation of complex shapes which go to make up machine beds and engine frames, and many other applications of this nature. In shipbuilding it is possible to transfer direct numerical data from 1/10 lofting drawings or the full-scale loft floor data directly into command signals for the machine. It may be mentioned here that it is the author's view that automation will have as an important a part to play in the batch production industries as in the larger mass production industries.

D

A modern trend in lighting is towards higher levels of illumination more comparable now with inside daylight levels than with the mere requirements of the visual tasks; for example, levels of up to 100 foot-candles for drawing offices are not uncommon nowadays. Fluorescent lighting is now most commonly used in industry since its advantages are overwhelming. This form of lighting is well adapted to integration with the building structure, an aspect of design which is receiving increasing attention today. Plant engineers will be interested to know that the 5 ft. tubular fluorescent lamp will shortly be available with a loading of up to 120 watts thus enabling about 50% more light to be produced from fluorescent fittings. Obvious savings will result in both capital and maintenance costs. Another trend is the increased co-ordination of natural and electric lighting by means of photo-electric automatic control. Photo cells face the sky, generally northwards, and are adjusted so as to bring on the interior lighting in stages as the daylight fades. In high, large shops such as foundries and rolling mills there is an increasing use of extra-high-wattage lamps, examples of which are the 1 and 2½ kilowatt mercury lamps which allow considerably higher illumination levels to be provided without adding appreciably to the number of lighting points. There is thus a considerable easement of the maintenance problem which is being further simplified by the incorporation into new buildings of ready access to the lighting equipment by means of cat-walks.

Science Museum Gas Publication

THE latest publication of the Ministry of Education in connection with the Science Museum is entitled 'Town Gas: Its Manufacture and Distribution.' The author, Mr. E. G. Stewart, a well known gas engineer, has given a detailed account in a concise but very readable form, of the early history of the discovery of coal gas and its development by Murdoch and Clegg. The early history of the formation of the Chartered Company of 1812, and the spread of gas manufacture to the provinces, are dealt with, though Mr. Stewart has not confined himself to this section of the early days of the industry only, but under such headings as carbonisation, gasification, purification, gasholders, and exhausters, has given the background to the development of the plant and processes concerned with gas production.

Anyone starting in the gas industry, even though he may not have seen the Gas Council's exhibit at the Science Museum, should read this book. Too often the student is liable to concentrate too much on the mechanisation of the industry as he finds it without concerning himself enough with the historical background which shows so clearly the difficulties which had to be surmounted by earlier generations of gas engineers.

The book supplies this without any conscious effort being made by the reader to do more than absorb an excellently distilled essence of the history of the industry. Mr. Stewart's style is particularly easy and even for those who are not students this book should make interesting reading, especially since the information to be found in it is right up to date.

The book is well illustrated by photographs both of the models and tableaux at the Science Museum and of modern plant lately installed by the area boards.

Pp. 52 H.M.S.O. Price 5s. 6d.

'Notes on Water Pollution'

A LEAFLET just published by the Department of Scientific and Industrial Research, 'Notes on Water Pollution No. 1,' is the first issue of a quarterly series which will deal with different aspects of water pollution and its control. The series is intended primarily for industry whose interest in problems of pollution has greatly increased in the past few years. The volume of work on industrial effluents undertaken by the Water Pollution Research Laboratory is being extended with the help of a considerable financial contribution from the Federation of British Industries, and a joint committee of the F.B.I. and the Board has been set up to advise on research on problems of pollution in which industry is particularly interested.

School of Welding Technology

TECHNOLOGICAL education is the greatest single need of British Industry today; scientific and technical developments are being made at an ever-increasing pace, and this new knowledge must be disseminated in a suitable form with the minimum of delay. It is a situation which challenges all organisations concerned with service to industry. In the field of welding and fabrication, the new School of Welding Technology is the answer of the Institute of Welding to the challenge and is backed by the support of nearly 5,000 individual members and member companies. The courses are planned to bring students up to date with the subjects covered, and to give them the latest information on design, fabrication, inspection, and research.

They are generally of the short, intensive, full-time type, but there is an evening course for structural designers and draughtsmen. The Institute plans to expand its programme for both full-time and evening courses as quickly as resources permit. At present, enrolments are accepted from any source, but it may be necessary in the future to give preference to individual members of the Institute and to the staff of member companies. The School is a permanent organisation at the disposal of industry; those responsible for its activities are constantly looking forward.

Much of the value of courses of this kind lies in informal discussion among students about their own technical problems. The Institute therefore provides opportunities for students to meet one another socially outside lecture hours, and has arranged for them to take lunch together. Participation in these informal contacts is an important part of the course. The full-time courses are intended for technologists; and students will be assumed to have received a full engineering training and to have at least a basic knowledge of the various welding processes.

New Tool for Pipework

DIFFICULT operations such as marking off branches and penetrations into, or dividing up pipes, ducts, boilers or other curved vessels, can easily be accomplished by the Ott radial centre-punch, 'ORKA I.' This tool is designed to suit outside diameters from 4,000 mm. to 40 mm. (13 ft. to 1.5 in.) and among the tasks it can simplify is the marking of keyways in shafts. The tool, which can also be used on internal diameters down to 450 mm. (1 ft. 6 in.) has scales from 0-180° and 180°-0, which operate in conjunction with a pointer and a precision spirit level. With the spirit level correctly set, the axis of the centre-punch is at the same inclination as the indication on the scale. The centre popmark is then made by the impact bolt. With a delicate surface, where the impact of the pop-mark would not be permitted, the impact bolt is replaced by cross wires so that the mark can be made with a scriber.

Das Gas-und Wasserfach. Vol. 99, No. 5, January 31, 1958, p. 120

Training Technical Authors

THE CITY AND GUILDS OF LONDON INSTITUTE have published a pamphlet containing the regulations and syllabuses for a new scheme of courses and examinations in technical authorship. There is a considerable shortage of competent technical authors, and the scheme of instruction is intended for those with engineering, technical, or scientific training and experience, who wish to become technical authors in industry or government service.

The course of training recommended has been designed with the needs of the younger entrants in mind, but the examinations will also be open to practising technical authors. The intermediate examination will be offered for the first time in 1960, and the final examination in 1961. The scheme is intended to meet an urgent need in industry, particularly in aircraft and vehicle manufacture, and in electrical and electronics manufactures.

From the Presidential Address to the Western Junior Gas Association, April 19.

Trends in Gas Compressor Design

By J. B. TAYLOR, M.Inst.Gas E.,
SAFETY AND TRAINING ENGINEER, SOUTH WESTERN GAS BOARD.

THE design of the gas compressor has remained fundamentally unchanged during the past 30 years, and there has been insufficient attention, in some instances, given to the means of coping with higher speeds which modern conditions require. Although crank-pin velocity and linear velocities of the reciprocating parts left a margin for increase, care must obviously be taken not to do this at the expense of efficiency. Economic considerations dictate the necessity of this rise in speed, partly to minimise the cost of compressor construction, but more especially to make possible the use of less costly and less bulky prime movers. The pre-war steam-driven compressor is most likely running today unchanged in design at 60 to 80% higher speeds with electric drives.

The main types of gas compressors are the aerodynamic (rotary) compressors which include the centrifugal or turbo-blower and aerial flow types, and the positive displacement compressors. The latter include the lobe and the sliding vane types, both rotary, and the reciprocating types with or without cranks or of the free piston type. In the aerodynamic type a pressure rise is achieved by velocity changes in a continuously flowing gas. The degree of velocity change is limited by pressure gradient on the blades. At all speeds, instability in flow can occur under certain operating conditions, thus causing 'surging.' A high pressure compressor must not be operated in this surging region.

Intermittent Flow

In the positive displacement types a volume of gas is trapped at low pressure and compressed by mechanical action. The flow is intermittent in nature, but in the high-speed rotary displacement compressor, delivery is virtually continuous due to the high frequencies of these intermittent deliveries. Such compressors can operate at any volume or pressure in the designed range. They have vertical characteristics, varying pressure with constant volume and constant speed. A large vertical compressor is a low speed machine, because inertia forces set up by the reciprocating parts must be maintained within certain limits. Thus it needs large foundations, *e.g.*, a 25 h.p. machine needs a foundation 3 ft. in depth, and a 1,000 h.p. machine an 8 ft. foundation. Usually a gas reservoir, or other means, is required to smooth out fluctuations in flow. The disadvantages in this type are: Internal lubrication is required on rubbing parts; the operating speed is limited by rubbing speeds, and the delivered gas is contaminated with oil.

In the sliding valve type internal lubrication is required on rubbing parts as in the case of reciprocating machines. The maximum running speed is limited by the excessive pressure which occurs, resulting in overheating, between the blades and the casing. This is assisted by interposing a freely rotating perforated drum between the blades and the casing, thus allowing a higher running speed and improved life. The pressure ratio is about 2:1, if uncooled and the capacity ranges from 3,000 cu.ft. per hour to 200,000 cu.ft. per hour. In the aerodynamic type the designer usually tries to obtain 'flat' characteristics, *i.e.*, constant pressure, with varying volume and constant speed. The pressure ratio is a function of impellor tip speed. At high pressures, a number of impellor stages are necessary, each having a low pressure rise in series, in order to keep a reasonable rotational speed. But increasing the number of stages, reduces the efficiency. At small volumetric flows and h.p. rises per stage, the flow path of impellor tips becomes small and efficiency is reduced.

The pressure ratio in the Howden/Lysholm compressor can be designed from 1¼:1 to 3½:1. The rotational speeds are lower than the speed of a centrifugal compressor and a high speed rotary machine gives almost continuous delivery. There are no internal rubbing parts, and therefore no internal lubrication is needed. The design permits freedom from vibration, and efficiency is maintained over very long periods. Single stage working can be adopted up to about 60 lb. per sq. in. gauge and cooling is adopted over 15 lb. per sq. in. gauge, although pressures of over 100 lb. per sq. in. gauge are in operation for two-stage compressors. Capacities range from 400 to 8,500 cu.ft. per minute but for gasworks requiring wide variations in pressure and capacity, two or more machines are recommended, in order to meet all requirements at the highest efficiency.

The axial flow compressor handles larger volumes and has a higher efficiency than a centrifugal machine. Its main characteristic is that compression is purely a function of speed. A range of capacity is possible for a particular speed, but it is more restricted by its proneness to 'surging' than a centrifugal compressor. The lobe type *e.g.*, the Roots compressor, is really a fluid transporter, *i.e.*, gas is transported from inlet to outlet at constant volume. Pressure rise is obtained because of back-flow from high pressure outlet pipe of some gas already compressed into the constant volume zone of the compressor. It is suitable for small pressure ratios, or for incompressible fluids, but is undesirable for high degrees of compression. Its efficiency is satisfactory up to a pressure ratio of 1.3:1, but above 5 lb. per sq. in. its efficiency gradually falls off.

The chief advantages of the reciprocating compressor are:

1. It comes into its own for pressures over 10 lb. per sq. in., there being no reasonable upper limit.

2. The volumes to be pumped fall within the practicable range of sizes, the limits being about 600,000 cu.ft. per hour (single stage) and 300,000 cu.ft. per hour (two stage). The two stage (twin cylinder, two cranks) arrangement becomes necessary over 40 lb. per sq. in. Piston speed must be limited to about 700 ft. per minute.

3. Vertical machines superseded the horizontal type some 25-30 years ago, because of a saving in floor space, simpler foundations, and the vertically reciprocating parts minimise wear. They are of totally enclosed forced lubrication construction.

4. The use of light Rogler Hoerbiger plate valves make ports and passages of large area possible. They are easily maintained, and give a large release area for a small lift of say $\frac{1}{16}$ in. or $\frac{1}{8}$ in. No friction is present and inertia is small; they have long life and tightness improves with time, so that years of trouble-free running are usually experienced.

Cutting Losses

The efficiency of a machine will be a good criterion of its power costs, but in order to draw attention to the money which is wasted by such plant, I recommend dwelling more on the 'losses' of our plant, and having analysed them, to consider how we may minimise them, both in plant under our control, and in plant to be installed in the future.

Losses in reciprocating compressors may be divided up into (1) mechanical losses, (2) compression losses, and (3) valve losses.

Mechanical losses. Power losses are due to friction in the bearings, gland packings and other sliding surfaces within the compressor itself. This mechanical friction varies very little with load, so that mechanical efficiency is at a maximum when the compressor is fully loaded. Frictional losses have a direct bearing on compressor operation and any decrease in such losses increase the mechanical efficiency, and thereby increase the overall efficiency of the compressor. Lubrication is, therefore, of the greatest importance. Correct lubrication keeps cylinder friction very low, but incorrect lubrication increases internal heating, adding to the heat of compression and correspondingly decreases the compression efficiency. In the case of the machine reported in an appendix to the address, the designer allowed for 22% mechanical losses, *i.e.*, assumed mechanical efficiency of 78% at full-load and speed. For com-

the Triton is new!

—a completely new and elegantly styled instantaneous gas water heater

The 'Triton' will meet all the hot-water requirements of the average household, is available for single-point bath use, or with swivel spout as a dual-point to bath and basin, or in multi-point form for direct coupling to existing hot water supply pipes to serve kitchen sink and both bathroom points. The special features of the 'Triton' include—modern style and compact form permitting flush fitting and ease of maintenance — integral draught diverter incorporated within the casing — automatic valve and two-stage and easy ignition — vitreous enamel finish in choice of cream or white. Ask for full details—

it's modern, it's multipurpose, it's MAIN

MAIN WATER HEATERS LTD.
Gothic Works, Thornton Rd., Croydon, Surrey

Note the name-made by MAIN

W130

pressors fundamentally similar it is notable that mechanical losses are claimed to be as low as 4½% to 6%, or 94% to 95% mechanical efficiency. This conflict of opinion is disturbing, particularly as it is so difficult to check. It is of the greatest importance in intallations where a constant speed motor is employed and where long periods of light load operation is necessary, for the purpose of maintaining a few pounds of pressure. Misunderstanding about this figure might cause an error in the decision to install a less expensive constant-speed motor. Tests with motor uncoupled and with motor coupled to compressor, but with all gas valves removed, confirmed losses at about 20% at full speed. Little reliance should be placed on this figure, because the gas (or air) displaced by the piston still has to traverse the narrow 'ports' communicating with the valve chests, and if restricted, the 'orifice' produces a load which varies in proportion to the square of the piston speed. There have been cases where the ports which connect the cylinders with the gas valves have been smaller in area than the valve-lift openings.

The author sought the opinion of a Professor of Mechanical Engineering, whose opinion was that for a 400 h.p. single stage compressor, mechanical losses consist of piston friction + other friction + pumping losses and occur in proportion 2:1:1 respectively. At medium speeds, losses would be 10 to 15% of b.h.p. divided up into piston friction 6%, other friction 3%, pumping losses 3%, bringing the total losses to 12%. The losses for a compressor operating with closed inlet valve, would be, piston friction 6%, other friction (bearings, etc.) 3%, giving a total of 9% (mechanical losses only). The Professor considered that the total losses at full load would be approximately equal to those at light load, because the inertia forces are high in relation to the gas forces. Thus friction is the same whether machine is compressing or not, and a claim of 4½ to 6% is, therefore, rather optimistic.

Compression losses. Improved design can keep the gas cool before entering the cylinder by short, streamlined gas passages, and by mounting the valves direct onto the cylinder, with inlet and outlet valves on opposite sides. In this way the gas becomes slightly preheated by contact with warm valves and passages, but in a well-designed compressor, the loss due to preheating could be estimated at 2%. The heat carried away by the gas, i.e., departure from isothermal conditions is the most serious source of loss in any compressor. Isothermal compression, i.e., with no temperature rise, could only be obtained in theory if a very long stroke was used, with small bore, very low speed, and extremely large cooling facilities. The main concentration of heat is in the cylinder head and although this is water-jacketed, as is also the cylinder wall, not more than 10% of the heat is carried away with the cooling water. In two-stage compressors (say over 60 lb. per sq. in.), inter-coolers limit this loss, but in single or two-stage machines, some 10% or 12% power must be wasted, i.e., about 50 h.p. for the type of compressors under consideration. Latest designs improve this loss by better water jacketing.

Greatest Saving

Valve losses. It is now becoming obvious that it is in valve design that there is the greatest saving in compressor losses; under some conditions losses from this cause can more than equal the total of other losses. It is, therefore, understandable that a major part of this address is being devoted to a study of compressor valve design, both from the efficiency and reliability point of view. Valve losses are considered under four headings: (a) Valve friction, (b) valve inertia, (c) valve port friction (i.e., communicating gas passages) and (d) gas leakage, assumed to be confined to valves.

Valve friction. An attempt has been made to assess this figure by treating the valve as a simple orifice, and by adopting the valve maker's discharge coefficient of .65. This cannot be very accurate but it gives us a good preliminary idea of the problem involved. The compressor concerned was of orthodox design and was the same type which was referred to previously. The significant point to note was the excessively high gas velocity of 250 ft. per sec. which produced the following conditions:—

1. Serious loss of efficiency, hence increased power absorption, when running at full speed; this makes itself very apparent at lower working pressures as a drop of 15 to 20%, or a drop of over 10% at 15 lb. per sq. in. which is the average initial pressure likely to obtain in practice in this area.

2. An increased power consumption of up to 40 h.p. compared with designed figure.

3. This increased power is revealed as heat. A graph chart showed how excessively this 'wire-drawing' effect produced temperatures much in excess of calculated figures (after allowing for water-cooling) and they also exceeded the theoretical adiabatic figure, calculated from usual formula.

4. Indicator cards would also have shown this defect, but the only set of cards obtained, had to be scrapped owing to a technical fault.

It may seem rather surprising that designers and purchasers have no accepted criterion by which to measure this most significant loss in simple terms. However, there is one arbitrary but most useful method of comparing the performance of compressors namely, the maximum mean gas velocity through the valve system. Sometimes this is called 'admissible fluid speed,' or 'gap speed' or 'lip speed,' the two expressions being self explanatory. This is calculated as follows:—

Gas speed = Mean piston speed × net piston area/valve flow area.

Valve-makers are agreed that for coal gas (sp. gr. .5) the maximum safe gap-speed lies somewhere between 160 and 180 ft. per sec.; beyond this speed, there will not only be very high valve losses, but gas turbulence which might initiate valve flutter, with resulting high fatigue stresses and temperature rise. For medium speed compressors with which we are concerned, it is necessary to employ lower gap-speeds than could be allowed in the case of high-speed machines (750 to 1,000 r.p.m.). Mean gap-speed is the most important factor in minimising pressure-drop through valves, and hence power absorbed, and to reduce this a low value is imperative. Some orthodox machines have been operating with electric drives at under 100 ft. per sec. and the modernised type operates at about 120 ft. per sec. In the author's view the correct and most sensible calculation is obtained thus:—

Valve flow area = total of perimeters of seat 'lips' × valve lift. There are usually eight seat lips for large compressors.

For Comparison Only

This figure, however, must only be used for purposes of comparison, as it takes no account of volumetric efficiency. Aerodynamic finish might help a little, but the standard finish is that of a good clean casting, without further machining or polishing, the cost of which would be considered prohibitive. Excessive spring tension adversely affects valve friction and is dealt with more fully later. Suction and delivery pipes must be very ample in capacity and free from sharp bends, to avoid excessive resistance and surging.

Valve inertia. This is the resistance in the opening of the valve, and can be seen clearly on the indicator diagrams by the 'humps' of the intake or discharge ordinate, i.e., at the end of the compression curve and re-expansion curve respectively. The mass of the valve plates, mechanical friction during valve lift (if any) and spring load are the factors which create these losses. In the case of the Gloucester new type machines, it is noteworthy that with maximum delivery pressure of 30 lb. per sq. in. gauge the peak cylinder pressure at the moment of delivery valve opening rises to 38 or 40 lb. per sq. in. for this reason. The percentage loss is reckoned at about 4%.

Valve port friction. The gas passages in orthodox machines which are essentially small and narrow to minimise clearance volume, have sometimes offered marked resistance to flow. It is reduced to a minimum in the uniflow principle where passages are ample, and very short. Losses from this cause can be kept under 2%.

Gas Leakage. Unlike an air compressor, external gas leakage can be safely ignored, but some high pressure gas inevitably returns to be re-cycled, partly because of imperfect valve seating, but more especially through valve flutter, where present and during the minute fraction of time that the suction valve takes to close. This is known as 'back-slip.' Valve springs cause speedy operation—at 300 r.p.m. the compressor makes 10 strokes per second, i.e., one stroke in 0.1 second. If the valve must operate within one hundredth of the stroke, the period of operation is 0.001 second. Some leakage must be expected past the piston rings, but in a well built, and well cared for machine, running on dust-free gas, good lubrication keeps this loss very low. In spite of these short periods, we lose another 2% efficiency in this way, even in a well designed machine.

There are four main types of valve which are used and readily available in this country.

1. Centrally-guided valves are the simplest type, which are distinguishable by the valve plate which floats freely on a guide, formed as a spigot on the top valve 'guard' (or it can consist of a hardened steel washer). In its elementary form, for small sizes, the valve plate takes the form of a plain steel machined ring closed by two similar split-rings which also act as cushion plates. The guard can be perforated to provide a larger passage area. To deal with large capacities, two, three or four annular ports can be provided in the cast iron seat, and instead of the valve consisting of two, three or four different rings, they are joined concentrically by bridges.

2. Frictionless-guided valves.—The main feature claimed for this type, which is really the basic Rogler-Hoerbiger design, is that it will function just as well in the vertical or horizontal position. This is made possible by the use of valve-plates with flexible guide arms, to eliminate friction and wear. In the smaller sizes, spring plates are used for suction valves, only, but in larger sizes, most makers prefer the use of coil springs. It should be noted that the use of spring plates reduces the clearance volume inherent in the design of the valve. Coil springs are commonly used in larger sizes, where this type of spring has less effect on clearance volume. These springs are housed in the guards whose construction may be in high duty nickel cast iron. Damper plates are incorporated for smooth running.

3. High-lift valves—normally of the frictionless type. The high-lift feature, which may be as much as $\frac{1}{8}$ in. or over in the larger sizes, compared with an absolute maximum of $\frac{1}{4}$ in. for normal type large valves. In one design this is made possible by riveting a guide-plate, held rigidly at the centre whose free arm ends are riveted to those of the valve plates. In addition, further dampening is produced by a spring-loaded damper plate suspended between the guide plate and the guard. Sizes are available up to the same maximum diameter as for standard valves.

4. High speed valves for high speed compressors (say 750 to 1,000 r.p.m.). These are distinguished by their shallow high-tensile steel seats and guards, compared with the normal cast iron. This allows a shallow construction and, therefore, a minimum clearance volume, but with maximum strength. One maker used two lentoid spring plates, and valve and spring plates are guided by a hardened steel ring. As sizes increase, spring plates are employed with frictionless valve plates and coil springs in top-size valves. Usually suction and delivery valves are of same type and size, differing only in the spring loading. For large machines a group of two or more valves may have to be used, to obtain an adequate total passage area.

Not So Obvious

The compressor piston's movement causes the pressure difference necessary to open the valves, which also creates the gas-flow through the valves. But the closing of the valves is not so obvious. In order to synchronise the cycle of the valve movement with the piston stroke, some form of spring load is of the greatest possible importance. At top-dead-centre the flow ceases, *i.e.*, the pressure differential momentarily becomes zero. It is just at this moment that quite a light spring must gently close the valve. If this was not so, the valve plate would return to its seat by the back-flow of gas which would cause heavy closing shocks, shortening the life of the plate. Equally serious might be the loss through 'back-slip.' If springs are too heavy, increased power will be necessary for driving the compressor, due to increased resistance for opening and flow; the valve plates would also be caused to chatter. From the volumetric point of view, the amount of the clearance volume should be kept to a minimum. However, it is important to note that the re-expansion of the trapped gas in the clearance volume lessens the opening shocks in suction valves and smoothes the load reversal on the crank, which would otherwise be sudden. The suction valve cannot open until the high pressure air remaining in the clearance space at the end of the working stroke has re-expanded. The first part of the suction stroke is, therefore, non-effective, thus reducing the capacity of the machine. The reduction in capacity is expressed as 'volumetric efficiency.' This figure must be under 100%. A high compression ratio will very much increase the weight of trapped air in the clearance space. This will decrease the effective portion of the suction stroke. On the other hand, an increase in the dimensions of the clearance space will produce the same result. These two points should be watched carefully by the designer, since a machine of low volumetric efficiency would obviously have to be proportionately larger in size, to harness a given capacity of gas. Conventionally, valve plates are of metal construction, and should be kept as light as possible, particularly in machines of higher speed; this minimises the forces required to open and close the valve, which in turn cuts down the losses. At the critical moment of valve opening, the gas pressure differential has to overcome; (a) the valve plate inertia, (b) the spring-load, (c) and the mechanical friction unless elastic guidance is provided, which produces 'humps' on the indicator diagram for suction and delivery valves. Consideration of the mechanics of the opening of a valve plate shows that just as the valve plate lifts from its seat, gas slips through the gap provided between the plate and the ledges of the seat. This increases (about double) the area exposed to gas pressure, and the sudden increase of operating forces accelerates the plate, causing hard opening shocks, at the end of compression curve and re-expansion curve respectively. In order to minimise losses due to valve opening and flow resistance, the seats should be made with narrow seating ledges, say about $\frac{3}{32}$ in. To sum up, losses can be reduced by using light valve plates, the use of correct spring tension, good design and finish of ports in the seats, plates and guards, and the avoidance of corners and sharp ends.

'Gap-speed'

The mean gas speed through valves (also known as 'gap-speed' or 'lip-speed') is probably the most important factor when selecting a suitable valve for a particular compressor. It is determined by the piston area and mean piston speed, and depends on (1) the type of compressor (single, multi-stage, etc.), (2) the compressor ratio, (3) the compressor speed (r.p.m.), (4) the specific gravity and properties of the gas, (5) the delivery pressure, and (6) the space available.

For fairly large single stage compressors, most designers prefer to operate at a maximum figure of 120 ft. per sec. though some prefer to keep under 100 ft. per sec., taking care that the cylinder ports are ample in area compared with valve areas. There is a natural tendency to raise this value if rotational speed is increased, for a given frame size of machine; this has, in fact occurred, over a period of years, where machines originally working with steam-engine drive at about 250 r.p.m. are now electrically driven machines at over 400 r.p.m. In such machines, it is usually reckoned that a gas velocity of much over 160 ft. per sec. will not only cause very high gas friction losses (increasing proportionately to the square of the speed), but turbulence may cause valve flutter and breakage, if the plates are at all brittle. When density increases, as at high pressures, flow resistance is markedly affected. Contrary to popular belief, valve plate lift is usually more than the thickness of the valve plates ($\frac{1}{16}$ in.) which has been quoted by other writers, and is determined by (a) compressor speed, and (b) gas density. Higher speeds and higher densities need lower valve lifts, so that special valves designed for high-lifts are used in low pressure compressors running at moderate speeds. The lower lift will clearly need valves of greater diameter (or a larger number of valves) to achieve the same passage area. Valve resistance to gas flow is governed by a number of factors, the main being; (1) the mass of the valve plate, (2) the load of the springs, (3) the mean gas speed through the valves, (4) the valve plate lift, (5) the density of the gas, (6) the width and number of ports in the seat and plates, and (7) the degree of aerodynamic finish of valve components. (It is at present considered too costly to polish the ports in cast iron seats and guards). The final decision in the choice of valves must remain a compromise between power consumption and volumetric efficiency.

Experience of engineers all over the country indicates that considerable trouble has been experienced over the past few years with valve plate fracture, which may cause an interruption with public gas supply, or failure to maintain pressures within statutory requirements, or damage to mechanical parts of compressor. Where clearance above and below the piston exceeds the valve plate thickness (say $\frac{1}{16}$ in.) further damage seldom results. An experienced attendant

would normally take action at the first signs of abnormal running, but difficulty mainly occurs with unattended machines. In any case, a broken valve-plate demands the immediate shutting down of the affected machine.

The variation in specification for steel valve plates is interesting, but very disconcerting, since it indicates that after 50 years' experience, there is no real agreement on this vital component. One maker would appear to favour lower lifts, which produce less wear, thus allowing a less hard material; while those makers who favour an alloy steel containing additives (molybdenum or vanadium) which give toughness, are firms who specialise solely in the manufacture of valves. They do not appear to claim any benefits as between one and the other. They have a very great responsibility in their control of stress-relieving (after die-piercing of slots), and further heat treatment in hardening and tempering. One of these firms tests the hardness of each individual plate rejecting those which fall outside the allowed tolerance. One is further tempted to ask whether the steel-maker's quality control of the medium carbon steel is as close as that which would obviously be required in the production of the alloy steel. Stainless steel (Grade FH) has been recommended for gas compressors, owing to possible chemical attack —it is slightly tougher than the alloy steels, and costs 20% or 25% more. The valve plate does not rise and fall uniformly, and this action has been described by one authority as resembling that of a drunkard, *i.e.*, it has an irregular rolling motion. The plate, therefore, hits the seat and the guard with its edge or tip. This further stresses the importance of spring design (bringing plate gently on to the seat) and lowest possible lift. The use and design of 'cushion' and 'damper' plates requires to be better understood. The cushion plate has no movement, and is not spring-loaded but lies flat on guard plate. It apparently relies on slight imperfection in flatness, or trapped lubricant or dirt for its effectiveness. Only one lift washer is used. The damper plate is spring loaded by one of several methods, and is held away from guard by one of the lift washers. There may be a washer between this plate and the valve plate, which has the effect of retarding the valve plate in three distinct phases.

Heavy Duty Machine

Present design trends. A modernised reciprocating type of compressor, of which examples have been installed in this area, is basically a heavy duty vertical two-stroke machine. It has been built either as a two-crank machine with one l.p. and one h.p. cylinder, or three-crank, with two l.p. cylinders and one h.p. cylinder, covering a range from 600 to 5,000 cu.ft. per minute. For low pressure air or gas a single stage of compression is used by substituting an additional l.p. cylinder for the h.p. cylinder. The salient points distinguishing this design are found in the cylinder arrangement, the valves, pistons and (on two-stage compressors) the intercooler. By making the water jacketted cylinder in one piece with the valve pockets in the cylinder barrel, the cylinder cover is simplified, air passages into the cover eliminated and any possibility of water leaks avoided. The construction gives short streamlined air passages and allows the most effective cooling of the cylinders, valve pockets and, particularly important, of the cylinder cover, where most of the heat generated by compression is concentrated. With the inlet and outlet valves on opposite sides of the cylinder, and the gas passages designed to give streamlined flow, there is no pre-heating by contact with warm valves and passages, and the uniflow movement of gas through the cylinders ensures the minimum pressure loss. The combination of low pressure loss, small clearance volumes and effective cooling, results in high efficiency with, consequently, low power input.

The framework, comprising bedplate, casing and separate crosshead guides, is of robust, cast iron design, and the whole, built of the most suitable materials with first class workmanship, adds up to a machine capable of, and designed for, continuous efficient duty.

The 'Clip' type valve. This new design of valve, while retaining the advantageous features of the conventional concentric ring type has a valve plate and the cushion plate which embody a new principle of construction and operation giving a higher standard of performance and reliability. The new type valve plate is a 'whole' member of uniform thickness throughout and forms a very stiff and light precision ground component. By 'whole' is meant that no cuts are made in any part to promote flexibility because that is not its function, and there are no separate attachments. The cushion plate is the flexible member of the assembly. It has an equal number of rings to the valve plate, but is divided at certain points to give the requisite flexing under the alternate loading by the pressure variation and/or the springs. The valve bolt and a dowel peg locate the cushion plate and the lift washer. The valve plate and the cushion plate are locked together by a spring claw, the mating portions of the claw being fashioned as integral parts of the two plates. In this way the valve plate floats freely, absolutely frictionless, but guided by the attached cushion plate; the cushion plate flexes allowing the valve plate to lift to the extent determined by the lift washer. The valve components are identical on the suction and delivery and differ only in their assembly.

As compared with the older types of valve, the advantages of the new design are the entire absence of friction and consequent elimination of wear, the light but stiff components give quieter running and allow quicker opening and closing with sustained tightness. Lower gas velocities are possible because of the greater effective port area in a given valve size, and the elimination of the centre springy portion allows an increased number of ports. The complete valve assembly is rigidly held in the cylinder by clamping the periphery of the valve seat, so that distortion of the seat is avoided.

Variable Displacement

Another advance in compressor design is the Rotary-Lobe type compressor with variable displacement and built-in pressure ratio. Rotary machines should give high efficiency, with very few wearing parts, low maintenance costs and long life. There should be no vibration, no surge-line or pulsation and the prime-mover can be of flameproof constant speed construction. There are indications that very great savings in first costs would be achieved by their adoption, and results of efficiency will be awaited with keen interest. The original compressor of this type was developed by the British Internal Combustion Engine Research Association, for use as a supercharger for diesel or petrol engines. The aim was to produce a compact and efficient unit and it was realised that, in order to obtain a higher efficiency than existing types gave, it would be necessary to design it with 'built-in' compression. In other words, the air or gas must be compressed during the working cycle before delivery. One advantage of this compression cycle is that any 'slip' of compressed gas takes place between the compression space and the constant pressure or 'carry-over' space and not back to the inlet. The energy of compression is not, therefore, completely lost, but assists in building up pressure in the subsequent cycle. The diagrams included with the address showed that the inner sleeves in both inlet and outlet branches are made in two pieces, an inner and an outer part. The inner part is made so as to be rotateable relative to the outer sleeve. On the outlet side, this feature is used to control or adjust the built-in compression ratio. The inner sleeve on the inlet side is shown in the fully retracted position. Rotation of the sleeve in a clockwise direction has the effect of curtailing the period during which the inlet valve is open. This can be used to adjust the volume being delivered without change of speed. Adjustment can be made to about 50% full volume by this means.

There is every indication that some of the leading manufacturers of compressors are facing up to the changing demands of the present time, and are looking ahead to the ultimate possibility of a national grid, or something akin to it. Each normal sized compressor today is potentially capable of consuming £16,000 to £20,000 per year of electricity, a nice thought for our competitors if current is purchased. Good design and intelligent operation can easily reduce this figure by £1,000, and in a board using £100,000 worth of electricity for compression, our responsibilities to achieve this are obvious. Diesel engines running on 200 second fuel oil (or heavier) merit still more serious consideration though a machine may cost £13,000 (without installation costs) and fire-risks have to be provided for. A less expensive oil engine running at higher speed can be used strategically in association with maximum demand alarms, in order to enable a works engineer to operate his tariff to better advantage. Waste heat recovery is a very attractive proposition with diesel installations having good load factors, making use of surplus heat from exhaust gases and cooling water. Tests have shown improvements in efficiency from the normal 35% to over 75% by this means.

"FILM" Flow

***FOR EFFICIENT INDUCED DRAUGHT COOLING TOWERS**

A compact and economical Cooling Tower which reduces recirculation problems, introduced by the specialists in the design and erection of mechanical and natural draught water cooling plant in timber, concrete and steel. Other "Film" Flow features are:

- ★ **Completely splashless in operation**
- ★ **No 'carry over' water losses**
- ★ **More efficient cooling**
- ★ **Minimum running costs**
- ★ **Lower pumping head**
- ★ **Less ground area**

Write for illustrated brochure to Dept. G.J.1.

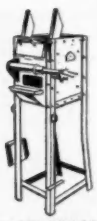
FCT

FILM COOLING TOWERS (1925) LTD

LIONEL ROAD · KEW BRIDGE · BRENTFORD · MIDDLESEX
Telephone: CHIswick 2935 Telegrams: Aloof Wesphone London.

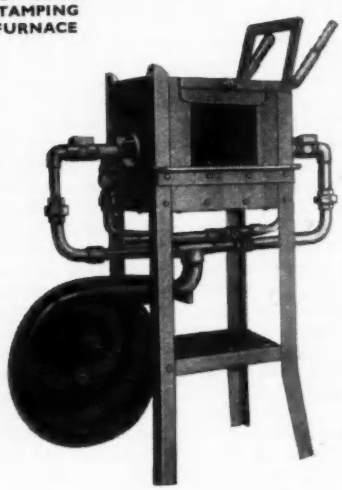
A. H. WILKES & CO.

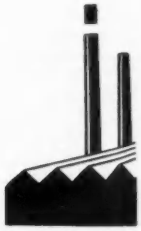
THE NAME IN INDUSTRIAL GAS EQUIPMENT



HOT BRASS STAMPING FURNACE

PORTABLE FURNACE





B.2140 FORGE.

A specially designed gas-fired Forge for heat treatment of pipes, angles, etc. Made in 3 sizes with capacities up to 6" dia. pipe 24" long. Hinged top for easy manipulation. Extensively used by Technical Colleges.

'ALCOSA'

PRODUCTS INCLUDE:- Blowers, brazing equipment, gas and oil burners, fans, furnaces, portable forges, soldering and tinsmith equipment, etc.

A. H. WILKES & CO.
A SUBSIDIARY OF WILLIAM ALLDAY & CO. LTD.

ALCOSA

Head Office: **"ALCOSA" WORKS, STOURPORT-ON-SEVERN, WORCS.**
Telephone: Stourport 2311-4 Telegrams: 'YADALL', Stourport
London Office: 158 Birchanger Rd., S. Norwood, S.E.25. Tel.: Addiscombe 1162 and 1295